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The Institute of Vitreous Enamellers

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and

The Foundry Trades' Equipment and Supplies Association

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The New Factories Act

Our legislators of 1874, fired no doubt by the success of the Act of some forty years earlier which emancipated close on a million black slaves in the world, turned their benevolent attention to almost a slavery flourishing on these shores. They enacted that, thenceforth, no child under nine years of age should be employed in a factory!

Humanitarianism is better applied in modern factory regulations, and the new Factories Act promulgated this year is an embodiment of some of the best thought on the subject. An excellent digest of the changes wrought by the new Act has recently been published.* A survey of this book makes it clear that a fair number of foundries, not less so other factories, must modify their ways and their facilities if they are to avoid falling foul of their new legal responsibilities.

The *leitmotiv* of the Act may be said to be contained in its opening passage, which is: "Every factory shall be kept in a clean state." Unlike many statutes, the present one does not leave to guess-work what it means. Dirt and refuse must in future be removed daily from benches, floors, passages and staircases. Windows and skylights must be kept clean inside and out, as far as practicable, and a sufficient standard of lighting, whether natural or artificial, must illuminate every part of a factory where people work or pass. A sidelight on the business intentions of the Act is that it about doubles the basis of penalties.

By July 1, 1939, suitable and efficient accommodation for washing, including soap and clean towels, or other means of cleaning and drying, must be provided and be conveniently accessible. One regrets that the law does not make it obligatory that these facilities shall be used each time work ceases for meals.

An excellent new provision is that all lifting machinery, including cranes, runways and, it should be noted, conveyors, shall have their safe working loads plainly marked on them, and shall not be used for greater loads. There must also be posted prominently in suitable places in the factory a table showing the safe working loads for all chains, ropes and lifting tackle, and such loads must not be exceeded. Whoever is *personally* responsible for any misuse is liable to a fine of £20, whether it result in an accident or not. A register containing the report of periodic competent inspections of all such machinery must be kept in future.

We regret to note that the new Act perpetuates the folly of earlier regulations of ordering chains and lifting-tackle (where suitable) to be annealed at stated periods without defining, even approximately, details of the suitable treatment. The strain put into chains used for lifting is a "cold working" and does not require for its release so high a temperature as is usually implied by "annealing." A quite dull red heat is sufficient, nor need this be maintained for more than a few minutes, after which the slowest cooling is best. We have seen chains put into furnaces for annealing along with steel castings. This can make the tackle less fit for service than if it had been left untouched. We have also seen chains thrown on a blacksmith's hearth and the blast let loose on them. Most definite orders against such treatments should be issued by the works manager.

It has happened too frequently in the past that difficulty in applying safety guards to some particular machinery has led to an inefficient outcome: either the machine could not be made reasonably safe, or its use was adversely affected. The new Act solves this with the wisdom of a Solomon. It throws the onus for a new machine being properly guarded, within itself, on the seller; and supports its argument with the alternative of a fine up to £100. We are effectively reminded, by a doubling (£20) of a previous fine, that detailed rates of wages payable for piece-work must be furnished in writing to the worker to enable him to compute money due to him; and a £20 fine is now the liability of a worker who discloses, for the purpose of divulging a trade secret, piece rates paid by his employer. A complete range of hours of work and overtime for women and young persons is laid down, and it is essential that executives should acquaint themselves with these, as they may vary from some present practice.

A salutary personal responsibility is now thrown on everyone employed in a factory, under penalty of a £20 fine, not wilfully to interfere with or misuse anything provided under the Act for the health, safety or welfare of fellow workers, nor to do anything likely to endanger himself or others; and apprentices are not excluded!

Liability to conform to the new Act in certain manner may be on the occupier (usually the employer), or it may be on the owner of the property, in the absence of eliminating contract between them. This is of vital importance in view of existing leases, and it is advisable to regulate the matter in friendly manner now to avoid disputes later as to responsibility.

(*Continued on page* 446.)

* "The Factories Act, 1937," by H. Samuels, M.A. Published by Stevens & Sons, Limited, 119 & 120, Chancery Lane, London. 584 pages. Price, 30s. net.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Sand Testing

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I have read with interest Mr. Buchanan's remarks in the November 25 issue, and would be pleased if you could find space for the following points.

(1) I agree that the B.C.I.R.A. method was not intended to be used at a single apparent density, but what standard density, or densities, are to be chosen for testing any given sand? Are these densities to be altered for other sands, or when the moisture, coal-dust clay, silt, iron pellets, sawdust, manure, etc., in the sand are varied, and if so, by how much? The moulder cares nothing about apparent density as he rams his mould, but he does know how much force he is using, and how much work he is doing. This principle is simulated in the A.F.A. method of ramming, as the work done in ramming is standardised, and not the apparent density. In fact, the density need not be recorded in the A.F.A. method, as it varies with the composition and the grading of the sand; these have considerable influence on the degree of ramming received by a B.C.I.R.A. test-piece, but none on the A.F.A. test-piece.

(2) In the course of testing twelve different sands (including three Scottish rock sands, red sands, synthetic sands, sea sands and facing mixtures) I have never observed an increase in the A.F.A. permeability number when the moisture has been increased above 6½ per cent., but rather the reverse. In fact, a point is reached when the moisture is high enough to render the sand completely water-logged, and the A.F.A. permeability is then nil. I am aware that no two sands behave alike, and it may be that Mr. Buchanan has struck a sand which becomes more permeable the wetter it is—surely a godsend for green-sand moulding. Nevertheless, there can only be one place for moisture in sand, and that is in the void spaces between the grains.

(3) and (4). I agree that the higher strength of the A.F.A. test-piece is partly due to its being relatively squat compared with the more slender proportions of the B.C.I.R.A. test-piece, but if the latter be cut into three equal lengths, the middle portion will be found to be lighter than either of the ends. Surely this proves that the double compression method produces a test-piece which is weakest in the middle. I have nothing further to add concerning the different green strengths registered by the two test-pieces when rammed to the same apparent density.

(5) My arguments also are based on the results of personal research work, except for the specific gravities of substances occurring in sands, which were taken from scientific tables. No matter what the specific gravity of clay, it will always affect the apparent density of sand by its presence (or absence) in the void spaces.

(6) My point is that any error in weighing, however small, will have a far greater effect on the results in the case of a B.C.I.R.A. than of an A.F.A. test-piece.

The use of more or less than three blows in the A.F.A. test may not be officially recommended, but is definitely of use in determining the properties of a sand under hard or soft ramming conditions.—Yours, etc.,

1, Huntly Drive, J. DEARDEN.
Cambuslang, Glasgow.

Classification of Foundry Sands

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—On reading through my Paper entitled "The Classification of Foundry Sands," which appeared on pages 419 and 420 of the issue of THE FOUNDRY TRADE JOURNAL dated November 25, 1937, I find that one point is not adequately explained. Sand grains are classified into ten groups in which the grains have no secondary bond, and ten in which they have secondary bond. The numbers referring to both sets of groups should be included to avoid any possibility of error.

In the first example, described on page 420, the figures on line C are given as 2 5 3 5, the final 5 describing the grains as being clean, subangular and rough. A fifth figure, 0, should be added to show that the sand has no secondary bond, this being evident from its group number of 0 in the classification of sands with secondary bond. If instead of being clean the grains had possessed a secondary bond, then the figures in line C would have read 2 5 3 0 5.

Precisely the same remarks apply to the figures given in line C for the second sample. For a sand with clean rounded smooth grains, the figures should read 0 0 9 1 0. If the sand had possessed secondary bond instead of having clean grains, the figures would have been 0 0 9 0 1. Since any sand must either have secondary bond or not, it is evident that one of the last two numbers in line C must always be 0. In the case of clean grains, the final 0 should always be added in order to avoid any uncertainty.—Yours, etc., T. R. WALKER.

The Priory,
Oughtibridge, near Sheffield.
December 6, 1937.

Defects in Chilled Rolls

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Your correspondent in Mysore inquires in your issue of November 25 how to avoid pulls and splits in chilled rolls 880 mm. by 330 mm. Apparently he has observed all the rules of the game, but it may be said that slender rolls, *i.e.*, with small diameter relative to the length, are somewhat liable to these troubles. Pulls can be avoided by moulding the top part in a weak sand and, if possible, loosening the sand 15 minutes after casting without puncturing the neck.

As regards splits, anything in the nature of a feather edge at the junction of the chill mould and the sand mould of the neck must be avoided.

The smaller size of in-runner would be more suitable, and stripping should not be done in less than 40 hours after casting, with the exception that the chill mould might be eased and put back again. It is assumed that the casting temperature is normal, as otherwise conditions as described seem normal.—Yours, etc.,

A. ALLISON.

Holmes Mills, Rotherham.
November 30, 1937.

The New Factories Act

(*Continued from page* 445.)

This appreciation of the new Act could not have been so readily conceived without the lucid exposition of the subject by Mr. Samuels' book, and we would urge those of our readers who are answerable for the correct application of factory law in their works to read the book and master their very important new responsibilities.

Many difficulties of interpretation previously experienced with the multitude of Acts and Orders, which the new Factories Act amends and consolidates into one, have disappeared. As the author of the above book suggests, gone are such anomalies as that of a ship fitter being a factory employee when in dry dock and something else when in wet dock! Nor do we find building operatives within Factory Act protection in the morning and outside it in the afternoon if the crane has been removed during the lunch-hour! The disappearance of the old distinctions between "factory" and "workshop" and between "textile" and "non-textile" factories is a further pointer to the common-sense basis of the new legislation, which is a monument of good government.

Random Shots

A speaker at a technical discussion not long ago prophesied that the day would soon come when coal-dust would be relegated to the foundry museum, and this brings to mind several other oddities which could be shown in this mythical collection. There would be, for instance, a gallery of wax models *à la* Tussaud, depicting on the right the foundry manager-who-isn't-an-expert-on-educational-matters. On the left there would be the foundry-foreman-whose-cupola-doesn't - always - give-sizzling - hot –metal. The centre-piece would consist of the after-dinner-speaker - at - a - foundry - dinner - who - has-never - been - known - to - refer - to - Tubal-Cain-nor-yet-to-Cinderella. At the back, almost hidden from view, would lurk the awful-apprentice - who - dared - to - disclose - the - whereabouts-of-the-foundry-cemetery.

* * *

"Marksman" has a little exhibit of his very own that would go well in such a museum, for although not strictly of foundry interest, yet is quite definitely a metallic oddity! It is a ball of silver paper bigger and heavier than any enthusiastic hospital collector's wildest dream, for those who have done any collecting know how difficult it is to get any weight worth mentioning. This one is 17 in. round its circumference and weighs 20 lbs. It is so solid that it looks like a solid cast metal ball. It is, by the way, an extraordinary example of the patience and concentration spent upon a single purpose, for it was made by a bedridden invalid, who day by day, as he lay in bed, only worked to see it grow larger and heavier; till at last it was too heavy for him to work at any more. His friends and children brought the silver paper to him every time they visited his bedside, and he welded the pieces together, not by any oxy-actylene process, but simply by the sugary dregs in his daily tea-cup!

* * *

It is a pity that there is so little romance left in this modern, scientific, and altogether too-hygienic world. All grown-ups know the familiar smell of the circus of their childhood days; that indescribable mixture of the smell of horses and orange peel. Whenever the circus is talked of in the family circle, as it always is at Christmas time, parents' nostrils sniff again at that peculiarly pungent odour, and little Tommy just thinks him a foolish old man, "because you know as well as I do, Dad, that the circus only smells of Flit." Someone ought to tell Mr. Bertram Mills about it, for what is a circus without its smell?

* * *

An extract from a newspaper of 100 years ago states that a certain late M.P. for Sheffield "is now lecturing at New York, where the mode of paying half-a-dollar to see an ex-M.P. of the British Parliament is said to be very productive." Last Friday some 120 members of the London Branch of the Institute of British Foundrymen paid considerably more than this for exactly the same thing, though, of course, they were able to enjoy a dish of asperges aux-fonds des artichaux at the same time.

* * *

FRENCH WITHOUT TEARS—III.

A young lady on her first visit to France explains to the hotel proprietor that her bed is not comfortable in the following way:—

"Le matelot dans mon lit est très dur.
Chez-moi, j'ai deux matelots dans mon lit."

"MARKSMAN."

High-Duty Iron

Mr. B. MacDougall, whose Paper on "High-Duty Iron" was published in our November 25 issue, points out that, in the twelfth line on page 408, the word "increased" should have read "decreased," and that the heading of the fourth column of Table IV should read "Total Carbon" (and not "Total Carbon Absorbed").

Some Notes on the Properties of Chilled Metallic Shot and Grit Used in Sand-Blasting*

By J. E. HURST (Past-President of the Institute of British Foundrymen) and J. H. D. BRADSHAW

The operation of cleaning castings for various purposes by sand- or shot-blasting has steadily grown into a process of major importance in many sections of the foundry industry. All the various types of plant designed for this purpose use abrasive materials in a granulated form, of which the most important are the various forms of metallic and silica abrasives. The metallic abrasives in the form of metallic shot and grit are now used extensively in place of sand or flint grit in all the various forms of sand-blasting machinery.

By metallic shot is understood the rounded more or less spherical particles of metallic material in contradistinction to the angular or cornered particles possessing a multiplicity of cutting edges which are referred to as metallic grit. In spite of the extensive replacement of sand and flint by metallic shot and grit the generic title "sand-blasting" as applied to this cleaning operation and the machinery used in it, still remains, and is used indiscriminately with the more recent and probably more satisfactory term of "shot-blasting." In addition to its use in cleaning operations in the foundry chilled metallic shot and grit find extensive use in the preparation of the surfaces of castings, forgings and sheets, for such purposes as enamelling, painting, cellulosing, electro-plating, galvanising, tinning and metal spraying. It is used also in the operations of stone sawing and cutting, rock and well boring, and in the concrete industries for the production of dustproof hard wearing surfaces.

Commercial varieties of metallic shot and grit appear to be described by some form of appellation including the word "steel," as for example "*chilled steel shot and grit*"; "*chilled alloy steel abrasives.*" This same practice persists in other countries. In Germany, for example, such phrases as "*Stahl-Sand*" and "*Diamant-Stahl*" are used, and in France this material is frequently referred to as "*Grenailles d'Acier.*" It may be that the inclusion of the word "steel" in the commercial description of this material can be justified on the grounds that a proportion of the metal mixture used in its manufacture may be steel.

Performance of Chilled Metallic Shot and Grit

Both shot and grit are manufactured in a range of sizes from finely powdered material less than 100 mesh in the case of grit, up to coarse grades, and it is found in practice that different sizes are suitable for different classes of work and for the production of different types of finish. For example, in general foundry cleaning operations the coarser sizes are recommended for large-size steel castings; the intermediate sizes for iron castings; and the finer grades for brasses, bronzes and the softer metals. Whilst both shot and grit are used for these general cleaning purposes it does appear that the use of grit is the more extensive, and it is probably found that owing to its angularity and the presence of cutting edges, grit is generally more efficient than shot. In the preparation of the surfaces of castings, etc., for enamelling or metal coating, grit is normally used.

It has been shown by Neville[1] and also by Bradshaw[2] that the character of the cleaned surface differs considerably, according to whether shot or grit is used. In the case of the former a surface which is described as a "peened" surface is obtained, in contrast to what is described as an etched surface obtained with grit. This latter is the surface finish desired by enamellers, as, in addition to providing a key for the enamel coat, it is found greatly to minimise defects which occur in the enamelling process. Exactly as in other operations, such as grinding, in which abrasive material is used, the size and character of the abrasive may have a very great influence on its performance both from the point of view of quality of work and also the service life of the shot and grit itself. In so far as the performance of shot and grit is affected by its size and character, this is in the hands of the user of the material. The shot and grit manufacturer produces a range of sizes and characters and the selection of the most suitable of these is in the hands of the user to meet the requirements of his particular class of work. In this, of course, the manufacturer of the shot and grit is able to assist by advice based upon the general knowledge that he has accumulated of the use of the material in its many applications; but it is clear that the final selection must depend upon trial and experiment to meet the user's exact requirements.

TABLE I.—*Results of Tests on Metallic Grit Used in the Preparation of Iron Castings for Enamelling.*

Test no.	Grit used per 100 lbs. of castings blasted.
1	2.016
2	3.412
3	3.083
4	2.909
5	2.958
6	2.629
7	3.688
8	3.176
9	4.522
10	3.923
11	3.429
12	7.756
SS	2.551

Performance Data

Two aspects of this question of the performance of metallic shot and grit which have attracted attention in the application of this material to the operations of cleaning castings, forgings and other articles are: (1) the comparative value of metallic and silica abrasives, and (2) the comparative value of different varieties of metallic abrasives. Experimental data and figures relating to these two factors are not only scarce in foundry literature, but are extremely difficult to obtain. According to Bradshaw,[2] from an economical point of view, chilled metallic shot and grit are distinctly advantageous when compared with sand, quartz or flint. Although more expensive in first cost, metallic grit has from 10 to 20 times the life of sand, and its use is accompanied by various other advantages, not the least being the reduction in the immense amount of dust which accompanies the use of sand. For some purposes metallic shot has a life of as much as 60 times that of sand. When cleaning castings for enamelling purposes it is usually estimated that 1 ton of chilled metallic grit will do the work of 16 tons of quartz.

Some detailed experimental results obtained from the cleaning department of a large Continental works handling from 2,500 to 3,500 tons per month of steel forgings and iron castings have been published ("Revue de Fonderie Moderne"). This class of work, of course, is entirely different from that of cleaning castings for enamelling purposes. The experience over a period of ten months, during which a total of 32,000 tons of material were cleaned by blasting, using metallic grit, proved the quantity used was less than 100 tons. It was stated that for the cleaning of a similar quantity of mixed forgings and castings, using sand, approximately 3,800 tons of sand would have been required. On the basis of these figures 1 ton of chilled metallic grit is approximately equal to 38 tons of sand. The saving in handling and storage charges in favour of metallic grit will be readily apparent from the figures quoted in this manner.

It is also stated that in addition to the economies realised by the use of metallic grit, much better results in appearance and finish were obtained, and in fact articles which presented difficulties in cleaning with sand were cleaned easily when metallic grit was used.

Nozzle Wear

A point of considerable interest regarding the wear of nozzles was recorded also. This was much less in the case of metallic abrasives than when sand was used and on an average the wear of nozzles with metallic grit was only one-fifth of that obtained with sand. Some results were obtained also which showed a saving in compressed air in favour of metallic grit. Over a period of two successive years with a correction for tonnage treated a saving in air consumption of 15 to 20 per cent. was obtained over that used in the case of sand. A further interesting point was brought out in these results, to the effect that the consumption of metallic grit was slightly greater in the cleaning of iron castings than in the case of cleaning forgings. This was attributed to the design of the castings treated and the fact that some of the abrasive remained in the interior portions of these and was not wholly recovered.

TABLE II.—*Chemical Composition of Chilled Metallic Shot and Grit.*

Sample no.	T.C. Per cent.	C.C. Per cent.	Gr. Per cent.	Si. Per cent.	Mn. Per cent.	S. Per cent.	P. Per cent.	Cr. Per cent.	Origin.
1	3.30	3.30	Nil	1.95	0.45	0.097	0.85	0.15	British.
2	3.32	3.32	„	1.83	0.36	0.098	1.24	0.14	„
3	3.11	3.11	„	1.88	0.30	0.092	1.28	0.14	„
4	3.00	3.00	„	1.95	0.34	0.165	1.31	0.10	„
5	3.21	3.21	„	2.07	0.38	0.125	1.19	0.087	„
6	2.90	2.90	„	1.50	0.35	0.15	1.20	0.10	„
7	2.95	2.95	„	1.23	0.41	0.155	1.09	0.45	„
8	3.11	3.11	„	1.87	0.40	0.119	1.19	0.07	„
9	3.00	3.00	„	1.10	0.33	0.166	1.09	0.33	American.
10	3.40	3.40	„	1.48	0.33	0.044	1.00	0.07	German.
11	3.18	3.18	„	1.64	0.33	0.106	1.15	0.11	„
12	3.14	3.14	„	1.30	0.33	0.162	0.93	0.19	Continental.
13	3.40	3.40	„	1.68	0.38	0.109	0.54	0.03	Unknown.

Life of Chilled Shot and Grit

It is clear that information regarding the comparative life of different varieties of metallic abrasives would be of great value. In the case of silica abrasives it is known that the pro-

* Paper read before the Sheffield Branch of the Institute of British Foundrymen on December 2.

1 FOUNDRY TRADE JOURNAL, March 21, 1935, p. 200.

2 Proc. I.B.F., 1935-36.

perties of silica sand can vary in sands of different origin, and that there is a substantial difference between the hardness and toughness of sand and such materials as quartz and flint grit. These differences in properties in different varieties of silicious materials probably have a large influence on their behaviour when used in sand-blasting. Similarly in the case of metallic grit, metallurgical knowledge indicates that the properties of hardness, toughness, and in fact all the physical and mechanical properties are capable of substantial variation according to the composition and the thermal treatment to which the metal is subjected. For these reasons it is to be expected that different varieties of metallic grit may show differences in life and service values according to their composition, treatment during manufacture, and physical and mechanical properties resulting therefrom.

There does not appear to be any reliable data published giving figures referring to the comparative life of different varieties of shot and grit. For this reason the figures given in Table I will be of value. These figures have been obtained from actual full-scale long-period tests in the shot-blasting of the same class of work using different varieties of metallic grit. The class of work was the preparation of cast-iron stove-grate castings for enamelling and every effort was made in each test to ensure comparative conditions. The many difficulties associated with tests of this description will be appreciated by all those familiar with sand-blasting operations, and it will be quite clear that no significance can be attached to the actual magnitude of the figures outside the particular class of work on which the results were obtained. Their significance lies in their comparative value, and they do show that under comparative conditions it is possible for different varieties of metallic grit to show differences in results. Obviously further experimental work of this character will constitute an important section of future research into the improvement in the character, properties and service value of metallic shot and grit.

The performance of metallic abrasives must be intimately connected with the mechanical and physical properties of the material, the grain size and shape, in addition to the efficiency of the particular design of blasting machine in which the abrasive is used. In connection with the mechanical properties it will be clear that the hardness and strength properties, including the toughness, will be of major importance, and may be expected to bear some relation to the behaviour of the material in regard to its cutting and wearing properties in addition to its resistance to disintegration. In so far as mechanical properties are concerned, these may well be the major properties in determining the life of any given size of metallic abrasives in service. In their turn the mechanical properties will depend upon the chemical composition and character of the material itself and the thermal treatment to which it is subjected during its manufacture. Both the grain size and shape are of importance also, and in their turn these are intimately connected with the manufacturing procedure.

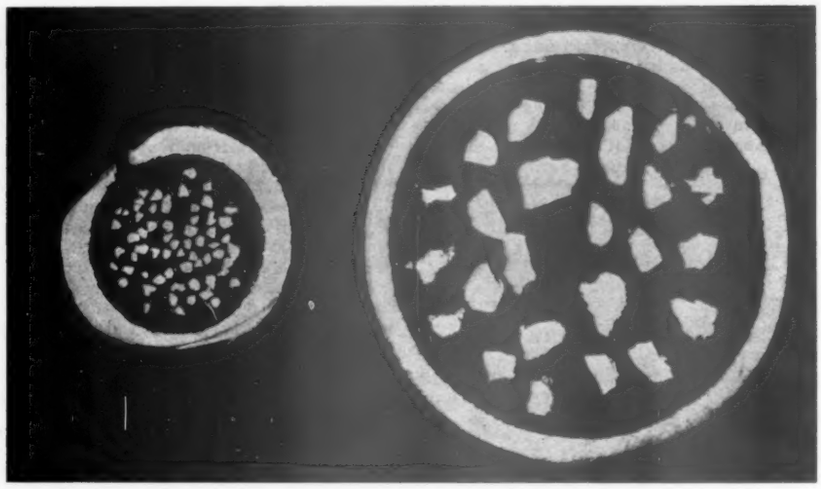

FIG. 1.—GRIT, MOUNTED FOR TESTING.

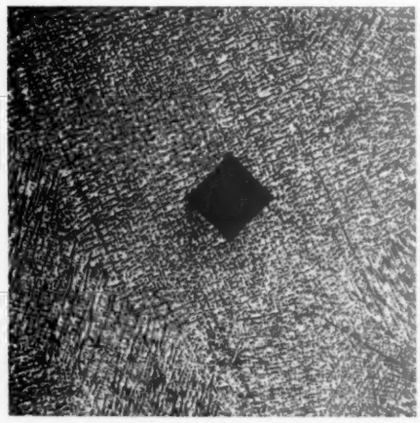

FIG. 2.—GRIT SHOWING F.D.H. IMPRESSION. ETCHED IN PICRIC ACID. × 50.

FIG. 1A.—GRIT, MOUNTED FOR TESTING. × 4.

Chemical Composition

The chemical composition of a number of samples of commercial varieties of both metallic shot and grit have been assembled in Table II. These have been selected from analyses made over a period of several years, and of specimens of different origin, and for this reason may be regarded as representative of the commercial varieties of this material available to-day.

On strict metallurgical grounds all these specimens of commercial chilled metallic shot and grit are more properly described as chilled white iron. Mention has been made already of the fact that this material is most generally described as steel. In all cases graphite is completely absent and the whole of the carbon is in the combined form. The total carbon contents in the analyses given range from 2.90 to 3.40 per cent., with amounts of silicon, manganese, sulphur and phosphorus which show clearly that the material is correctly classified as chilled white iron. All these analyses show that the material contained chromium, but with the exception of specimens Nos. 7 and 9, the amount of this element is small and cannot of necessity be regarded as having been added intentionally. The amount present in No. 7 and No. 9 is substantially larger, and in one case it is known to have been added deliberately.

Hardness

The hardness of actual shot grains can be measured best by diamond hardness testing, using either the Firth, Vickers or Rockwell hardness testing machines. The two former methods are recommended for the reason that they enable low indenting pressures being applied, thus avoiding the breaking of the small grains which is the difficulty associated with the use of larger indenting loads. The Firth diamond hardness machine using a 10 kilogramme load is used in the authors' laboratories. A recommended procedure in mounting specimens is to press a number of grains of shot to be tested into a small cake of white metal alloy. Embedded in this matrix the grains can be ground and polished to leave flat surfaces suitable for diamond hardness testing. A typical test specimen prepared in this manner is illustrated in Fig. 1, and a magnified view of the diamond hardness impression obtained with the Firth hardness testing machine using a 10 kg. load is shown in Fig. 2.

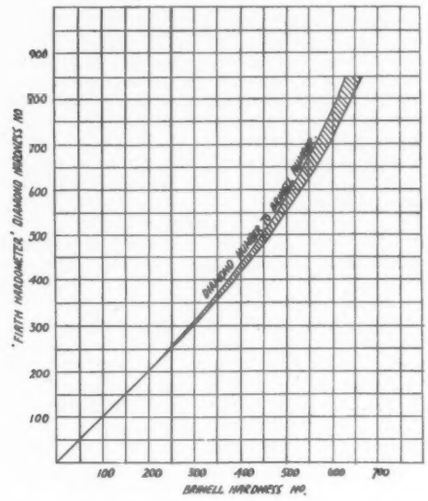

FIG. 3.—APPROXIMATE COMPARISON BETWEEN BRINELL HARDNESS NUMBER AND FIRTH DIAMOND HARDNESS NUMBER.

(A definite comparison cannot be given, but the comparative values within the shaded area shown will serve as a general guide.)

TABLE III.—*Firth Diamond Hardness of Chilled Metallic Shot and Grit.*

Specimen no.	1	2	3	4	5	Origin.
1	882	882	882	882	882	British.
2	902	824	882	824	824	,,
3	724	824	681	724	—	,,
4	824	681	1,081	882	882	,,
5	946	882	824	824	824	,,
6	946	724	824	824	824	,,
7	824	882	946	882	882	Continental.

A collection of hardness results determined in this manner on a number of specimens of grit obtained from different sources is assembled in Table III. The results for each specimen in the table are given on separate grains of shot from the same sample and in some cases, as for examples Nos. 3 and 4 in the table, a substantial variation in the hardness value is revealed. Results of this kind emphasise the need for testing a number of grains from any one sample in order to obtain a representative hardness figure for the sample as a whole. Diamond hardness numerals in their range of hardness differ slightly from ordinary Brinell hardness numbers obtained

(*Continued on page 450.*)

The Institute of British Foundrymen

LONDON BRANCH ANNUAL DINNER

The London Branch of the Institute of British Foundrymen entertained a number of guests and shared a happy evening with them on the occasion of its Annual Dinner last Friday, at the Charing Cross Hotel, London, W.C.2. Dr. A. B. Everest (Branch-President) was in the chair.

The company included the Right Honourable J. H. Thomas, P.C.; Mr. C. W. Bigg (President of the Institute); Mr. C. C. Booth, J.P., and Mr. Barrington Hooper, C.B.E. (Branch Vice-Presidents); Mr. V. Delport (immediate Past-President of the Branch); Mr. L. J. Tibbenham (chairman of the East Anglian Section); Mr. C. W. Hayward; Mr. Kenneth Bridges (of F. W. Bridges & Company, who organise the Foundry Exhibitions); Mr. G. Shaw Scott (Secretary, Institute of Metals); Mr. V. C. Faulkner (Past-President of the Institute and of the Branch); Mr. R. Causebrooke (Branch Hon. Secretary), and MR. H. W. Lockwood (who recently retired from the office of Branch Hon. Secretary, and to whom a presentation was made as a mark of esteem and of gratitude for his services in that capacity).

A telegram wishing the members and their guests a happy evening was received from Mr. F. O. Blackwell (Past Branch-President). Messages regretting absence were also received from Mr. T. Makemson (General Secretary of the Institute), who unfortunately was ill; and from Mr. W. B. Lake, J.P. (Vice-President of the Institute).

The Toasts

The loyal toast having been honoured,

THE RT. HON. J. H. THOMAS, P.C., proposed "The London Branch of the Institute of British Foundrymen," in a speech interspersed with stories illustrative of his points, and having in some cases a foundry orientation. The gathering, he said, was one that was very likely to be misunderstood. He was invited to a gathering of foundrymen. But when he looked around the room he saw a gathering of good-looking and aristocratic gentlemen with æsthetic tastes, and he was inclined to ask himself how they had become foundrymen; and he was quite sure that they themselves would have difficulty in answering the question!

After discussing the antiquity of the industry and the skill of its craftsmen, he said that in this changed and changing world the old British Empire, with all its defects and all its imperfections, stood out as a beacon light. One reason was that fundamentally our people had a desire to play the game. Another factor which had made our country and our Empire great was the craftsmanship which, thank God, we had not wholly lost, although in these modern days it might be more difficult to keep it going. In no other country in the world could men meet in such circumstances of freedom and happiness as in this country, a fact of which we should all be proud. Foundrymen must be proud of their craft for, with all the changes in industrial life, they and their products were always essential to the community. How fitting and wise, therefore, that they should have associated themselves together; although competitors, they were all inspired by the importance of their craft and were co-operating to ensure its proper development.

Good Progress Registered

The BRANCH-PRESIDENT (Dr. A. B. Everest), responding, remarked jocularly, *apropos* Mr. Thomas' reference to foundrymen, that he had very serious doubts as to whether he was a gentleman or a foundryman! Speaking of the work of the Branch and of the Institute as a whole—for the activities of the individual Branches were the activities of the Institute—he commented upon the great development of foundry practice during the past twenty years, both in connection with cast iron and non-ferrous metals, and said it could justly be claimed that in all that development the Institute had played a very important part. He was proud to be a member of the Institute, and proud to represent the London Branch as its President on that occasion. The Institute of British Foundrymen was one of the most virile and active of the technical institutes existing to-day; it had the interests of the industry most closely at heart, and was perhaps most closely coupled with the industry.

It had reached its present position of great activity as a result of its policy of holding technical meetings in different centres and fostering the exchange of information and the discussion of technical problems, in getting foundrymen together, breaking down barriers of reticence and secrecy and giving them opportunities to work together for the development of the industry as a whole. The Institute had played a very active part in technical development through the medium of its Technical Committee, which was formed a few years ago, and which crystallised the Institute's technical activities. The London Branch had played a very prominent part in connection with the activities of that Committee and the other activities of the Institute, and could fairly claim to have given its fair share of work and to have accepted its fair share of responsibility. Mr. V. Delport (Immediate Past-President of the Branch), as chairman of the Costing Sub-Committee of the Technical Committee, had carried through, with the aid of his colleagues, a creditable piece of work in preparing the reports of that Sub-Committee; and that work had almost reached a state of finality, in that a complete report had been published, and it was up to the members of the Institute to put its recommendations into practice.

The Cast Iron Sub-Committee had been very active also. Quite recently a Committee of the British Standards Institution had passed for publication the new specification for high-duty cast irons and the revision of the original grey cast iron specifications. He believed the specification had passed through its various stages in record time; the period from the date of the first meeting which was held to consider the specification to the date of its publication—which he hoped would be shortly—would be the shortest period involved in the preparation of any new specification. The work of the Technical Committee of the Institute, in collaboration with the British Cast Iron Research Association, had been one of the principal factors in getting that specification through; and, again, the London Branch could claim a fair share of the credit.

The Non-Ferrous Metals Sub-Committee also had made great progress, and various proposals were before the British Standards Institution. In connection with standardisation and testing generally, the Technical Committee was playing a very active part on behalf of the Institute.

The London Branch has pulled its weight in dealing with the very serious problems concerning the education of the young personnel of the industry, in the training of those who were to be the executives and workers to follow on after the present generation had passed. The progress of the Branch could be regarded as typical of the Institute as a whole. Whereas in 1931 the membership of the Branch was 208, it had since increased to 314, which constituted a record. The Branch had tremendous responsibility by reason of the territory which it covered, comprising practically the whole of Southern England, from East Anglia to Cornwall. That presented its problems in a way, but on the other hand it gave the Branch special work in keeping together the foundry industries over the whole of that area.

Healthy Offspring

The East Anglian Section was formed about 18 months ago, and was a very flourishing offspring of the London Branch. He was glad to welcome Mr. Tibbenham (Chairman of the East Anglian Section) at the Branch dinner.

Credit could be claimed by the Branch also for the development of the South African Section, the formation of which indicated how far the influence of the London Branch extended. Some three or four members of the Branch, resident in South Africa, had visited this country from time to time and had discussed their ideas with members here, the result being the formation of the South African Section about a year ago.

The activities of the Branch were definitely broadening, and the programme for the session was extremely full. A special feature was the development of the policy of arranging joint meetings, in which development the London Branch was a pioneer. He mentioned the joint meeting held some time ago with the East Midlands Branch and the contacts made with the Birmingham Branch last year in London and this year in Birmingham. In addition, it was making contact more and more with other technical institutes a very important part of its work, in which it was particularly well suited to participate, because the foundry industry touched any number of other industries. For some years past there had been joint meetings with the London Section of the Institute of Metals, and a joint meeting was to be held with the Southern Section of The Institute of Vitreous Enamellers. In the spring it was hoped to tour some of the very important foundry establishments in the West Country, and to bring them more closely into touch with the Institute as a whole.

The International Congress

In a plea for support of the General Council's efforts to develop a bigger and better Institute, he said the members could do much by attendance at meetings and by urging their friends in the industry to support the Institute also; only by weight of numbers and keen interest could the Institute carry forward the reforms that were being considered. He also mentioned the International Congress, to be held in London two years hence, when it was hoped that Mr. W. B. Lake, J.P. (a Past-President of the Branch), would be President of the Institute. The Branch would have a very prominent part to play in the organisation of that Congress, and in welcoming to London the members of the Institute generally and the members of the various bodies which were co-operating.

Presentation to Mr. H. W. Lockwood

To mark the esteem of members of the Branch for Mr. Lockwood, and their gratitude to him for his work on their behalf in the capacity of Hon. Secretary of the Branch during the past five or six years, they had subscribed to make a presentation to him, which took the form of a cabinet of cutlery.

The BRANCH-PRESIDENT drew attention to the fact that since 1931, when Mr. Lockwood had become Hon. Secretary, the membership of the Branch had increased by about 50 per cent., and said that the success of the Branch had been due in great measure to his activities. In the spring of this year he had resigned because of pressure of business, and the members of the Branch wished to express their appreciation to him in tangible form.

MR. C. W. BIGG (President of the Institute), who made the presentation, said that nothing that he was asked to do would afford him greater pleasure than to ask Mr. Lockwood to accept the cabinet as a token of appreciation of his services and of the esteem in which he was held by his colleagues. To his great efficiency, dear old "Lockie" added the charm of good fellowship, and all the members would retain for him a real personal friendship.

Amid applause, Mr. Bigg handed to Mr. Lockwood the key of the cabinet, and received in return the traditional coin.

MR. H. W. LOCKWOOD was received with musical honours. Responding, he said it had been an honour to serve the Branch as Hon. Secretary. When he had accepted office he was little known; but he had found himself immediately in the most friendly atmosphere he had ever experienced in his life, and for such work as he had been able to do he was amply repaid by the friendships he had made. He paid tribute particularly to Mr. V. C. Faulkner, a Past-President of the Institute and of the Branch, and a Past Hon. Secretary of the Branch, and said that only an Hon. Secretary could appreciate what a tower of strength he was to the Branch; he was most generous in all he did. (Applause.) Another to whom Mr. Lockwood paid tribute was Mr. Makemson, the General Secretary of the Institute. The correspondence between them had been always of the happiest possible character, and whenever they had had a sticky problem to solve they had solved it without formality. He wished Mr. Makemson could have been present at the dinner, so that he could have said "Thank you, Tom, for all your kindness." (Applause.)

In wishing his successor, Mr. R. Causebrooke, good luck, he said it was perhaps significant that the first Branch Dinner Mr. Causebrooke had organised was marked by a record attendance.

Finally, Mr. Lockwood said that, having been honoured by election to the Branch Council, he hoped he would be allowed to serve the Branch in the years to come.

The Visitors

MR. C. C. BOOTH, J.P. (Vice-President of the Branch), proposed a toast to "the many distinguished, learned and other visitors" present. He mentioned particularly the Rt. Hon. J. H. Thomas, P.C.; Mr. C. W. Bigg (President of the Institute); Mr. C. W. Hayward (a director of a large number of concerns); Mr. G. Shaw Scott (secretary of the Institute of Metals); Mr. L. J. Tibbenham (chairman of the East Anglian Section of the London Branch); Mr. Kenneth Bridges; Mr. R. A. Jones (President of the Lancashire Branch of the Institute); and representatives of the Press. To all the visitors he extended a hearty welcome, and jocularly offered to Mr. Kenneth Bridges the advice that he might refrain from stating the closing time of the exhibitions on his advertising cards, because, when members missed their last trains, their wives wanted to know why!

"Buff Card" Speeches

MR. C. W. BIGG (President of the Institute), responding, remarked jocularly that he felt he would have been justified in producing a little buff card and reading from it something which closely approximated either to wisdom or to wickedness; but, realising that possibly quite a number of those present had already digested Mr. Barrington Hooper's anthology, he would refrain. His knowledge of foundrymen led him to suggest that for his next effort Mr. Barrington Hooper might give serious consideration to the compilation of a Foundry Lexicon, which should be cross-indexed with foundry problems so as to provide appropriate and adequate expressions for every occasion!

Assuring the Branch that its delightful hospitality was keenly appreciated by all the guests, he said that both in his personal and official capacities he derived the very greatest pleasure from attending the annual dinner of so important a section of the Institute as the London Branch.

It was most appropriate that the Branch, representing the Institute in the Metropolis, should be impressive with regard to both quantity and quality; whilst it was possible to congratulate the Branch upon the considerable increase in its numbers from year to year, it gave him greater pleasure still to refer to the quality which was exemplified in the contributions the Branch made to the work and progress of the Institute as a whole. It was with the greatest pleasure that he endorsed all that had been said that evening with regard to the Branch.

Mr. Kain's Views Examined

He was tempted to say that not every Branch could produce a member with the courage to present a Paper entitled "Can the Metallurgist Run a Foundry?" And, having read the Paper, as published in the JOURNAL, he was afraid that the courage of even that London member was not quite sufficient to enable him to give a really conclusive reply to his own question. Mr. Bigg said he was not acquainted with the replies the author had received during the discussion, but could readily imagine the reply he would get in many foundries—which would be conclusive and decidedly Pygmalionish!

But Mr. Bigg's own courage did not sufficiently outweigh his discretion to allow him on that occasion to disclose his own views on the matter. He recalled some expressions of opinion in the Paper, however, as indicating a problem. The author had indicated that the problem for the foundry industry was primarily one of economics, and he had stressed the importance of output; but later on he had emphasised even more the evils which, in his opinion, were attendant upon standardisation and modern methods of production. He had quoted Adam Smith, that "industrial specialisation is simply mental mutilation."

The author of the Paper would not object to the suggestion that there was a contradiction in those statements. But Mr. Bigg's real object in raising the matter was to suggest that one of the problems before the Institute was that of bringing about a reconciliation between those apparently opposing points of view.

Standardisation and Specialisation

He claimed that the results of standardisation and specialisation had not been altogether detrimental to our well-being. It would be agreed that we had made economic progress, that the amenities of life within reach of the ordinary individual to-day were out of all comparison with those formerly within reach of our grandfathers; and although he admitted that there were still some shoddy things sold, yet in general everything we made was better and we were able to obtain infinitely more of everything than was the case formerly. Standardisation and specialisation were largely responsible for that. He endeavoured to justify standardisation by saying that, no matter what job one had to perform, there was a best way of performing it; and surely there was much to be said for the discovery and standardisation of that best way. And, with regard to specialisation in industry, it was sufficient to say that, had there been no specialisation, there would have been no metallurgists. He claimed that those two factors of standardisation and specialisation were necessary to ensure our industrial and social progress, and to achieve economic production.

Modern Work Less Monotonous

Mr. Kain had argued that modern methods were likely to produce mass stupidity as well as mass production. On the other hand, was it not easy to imagine the laboriously monotonous tasks which had had to be performed before the age of machinery? He would hazard the opinion that the proportion of workers engaged on monotonous labour to-day was not tremendously greater than it was formerly.

He agreed with the author that "development and progress can best come from men and not from machines." Indeed, he emphasised it by saying that, no matter what job one had to do, or how one did it, "grey matter" must be introduced somewhere if it were to be done successfully; and there was more scope for brains and initiative under modern than under ancient methods. Much of the knowledge in the foundry industry was still in the hands and heads of the craftsmen, and he shared the author's concern that, with increased standardisation and specialisation, the scope of and facilities for the training of those craftsmen were decreasing. But that was not sufficient ground for the condemnation of modern methods. Rather should it be the policy of the Institute to take advantage of every method and device for more economic production and the elimination of sweat and grime from the industry; parallel with that, they should aim at ensuring the training of a continuous supply of craftsmen whose individual skill was informed by a greater technical knowledge than that of their predecessors.

From Foundry to Finance

MR. C. W. HAYWARD, who also responded for the visitors and thanked the London Branch on their behalf, addressed his hearers as "mates," for he had started his career as a foundryman.

MR. THOMAS: And you found it did not pay!

MR. HAYWARD, continuing, said that at the age of 14 years he had attended evening classes on machine drawing, and later had served in the patternshop, the core shop and the foundry. There was laughter when he referred to his happy recollections of the shops, and of trying to get his patterns out of the mould. But later he had entered the financial field.

In wishing his fellow foundrymen every success, Mr. Hayward said he hoped to see the foundry industry of this country on top of the world; from what he had seen of his hosts that evening, he was sure that everything possible was being done to that end.

The Branch-President

A toast to Dr. Everest, in appreciation of the ability with which he had presided over one of the jolliest gatherings in the history of the Branch, was proposed by Mr. Barrington Hooper, C.B.E. (Vice-President), and was received with musical honours.

Musical entertainment was interspersed between the speeches during the evening, the artistes being Miss Kitty Keys and Miss Constance Groome (the Two Good Girls); Mr. Fred Wilden (entertainer); Carlo (with his accordion); and Mr. Harry Tait (at the piano). The official proceedings concluded within reasonable time, affording members the opportunity for informal intercourse.

Some Notes on the Properties, etc.

(*Continued from page* 448.)

with hardened steel ball indenters. The extent of this difference is illustrated by the graph in Fig. 3, and it will be seen that the diamond numerals are slightly higher than the ordinary Brinell figures. It is probably true to say that the Firth diamond hardness results obtained on shot or grit lower than 750 may be considered to be on the soft side and samples showing irregularity, including results lower than this, may be regarded as soft in character.

TABLE IV.—*Firth Diamond Hardness of Sand-Cast White Irons.*

	T.C. Per cent.	Si. Per cent.	Mn. Per cent.	S. Per cent.	P. Per cent.	Cr. Per cent.	F.D.H.
300	3.14	0.62	0.64	0.136	1.21	0.04	464/500
325	3.30	0.92	0.56	0.186	1.10	0.68	606/588

These hardness results are substantially higher than those obtained on the general varieties of hard white iron in the sand-cast condition. For the sake of comparison the results in Table IV were obtained on two commercial varieties of hard white iron grinding plates. Plate No. 1 is an ordinary quality of white iron and No. 2 a special quality of chromium alloy cast iron, both in the sand cast condition. The difference in hardness value is substantial and this is due almost entirely to the drastic quenching effect to which shot and grit material is subjected during its manufacture.

(*To be continued.*)

Examples of Practical Moulding*

By F. G. BUTTERS

After carefully considering the subject of practical moulding, and realising the wide field it covered, it was thought advisable for the purpose of this Paper to confine it to several examples. Whilst to some this Paper may appear elementary in character, it is very often the overlooking of elementary details which causes a number of troubles in the foundry.

In dealing with some of these troubles, an endeavour has been made to explain and illustrate in a clear and concise manner various fundamental principles of practical moulding. Moulding is a trade demanding more technical skill and forethought and involving more difficulties than many trades of greater apparent importance, and as its practice is very varied and extensive, and a thoroughly exhaustive treatment would occupy a much longer Paper than is deemed possible, judicious condensation is necessary.

The moulds into which iron is poured in order to obtain castings of definite outlines are invariably either of sand or iron. The process in which the latter is used is a small and comparatively restricted section known as chilling, or permanent moulds; the former embraces all the ordinary iron castings.

Sands

Sand is pre-eminently adapted for receiving liquid metals, there being few materials to replace it, because there are few which are at the same time plastic, permeable, firm and refractory. Plasticity is necessary in order that the matrix may be moulded into any form, intricate or otherwise. Permeability is essential to permit of the free escape from the moulds of the gases generated by casting, and firmness is necessary to ensure the mould being able to withstand the liquid pressure of the molten metal. The matrix must also be refractory, that is, able to resist the disintegrating influence of great heat and the chemical action of the hot metal itself. It must, moreover, be cheap, readily available and easy to use. All these qualities are possessed by certain sands, and mixtures of sands. The leading branches of moulding derive their names from the different kinds of sand mixtures used, which are termed green sand, dry sand and loam.

That sands differ widely in their physical qualities is apparent to any observant person. While one kind is sharp, open and friable, another is clayey, heavily bonded and dense. Advantage is taken of these differences in quality to obtain mixtures suitable for every class of work, from the lightest casting to the most massive and heaviest types. Almost invariably, therefore, foundry sand consists of mixtures of various separate kinds. By discriminate mixing, grades of any required character can be obtained.

Patterns

To enable the sand to take the requisite impressions and outlines, it is necessary to employ patterns, the shapes of which are usually the counterpart of the castings required. Patterns are in some cases exactly like their castings, but in others they resemble them only to a certain extent. Thus, if the castings are to be hollow, the hollow portions, instead of being provided in the patterns, may be much better formed by cores, prints on the patterns indicating their positions, and the print impressions affording them support. In large work the patterns are sometimes mere skeletons, or profile forms, the moulds themselves being prepared mainly by a process of sweeping or strickling. Although brief reference has been made to the three branches of moulding, namely, green sand, dry sand, and loam, the examples dealt with will be confined to the two former branches.

A Mower Frame Casing

The first example is a double-sided pattern-plate of a mower frame, its weight being approximately 6 cwts. This casting is made in green sand, the following being a detailed description of the method of moulding.

Good Moulding Box Essential. — In selecting the box for this type of casting, provision has to be made not only for the pattern, but the plate that is to be built round it, which varies to a great extent in outside shape, also in contour. The box used measures 6 ft. by 5 ft. Apart from outside dimensions the cope and drag must have good joint faces, as the accurate building-up of the plate is entirely dependent on this. It must also be a good fit on the pins to ensure the correct registration of the two sides of the plate.

Correct Setting of Pattern.—This operation is worthy of careful consideration, as a few minutes' study at this stage may save hours of unnecessary work during the making of the mould. In the first place the centre-line of the joint is found, and the pattern placed in the cope at such a depth that the highest and lowest points of the joint are equally divided, thereby keeping to a minimum the depth of sand that has to be lifted. The advantage is twofold, as it applies to the pattern-plate and the subsequent moulds made from it. The packing of the pattern where it does not rest firmly on the cope must not be overlooked, or serious trouble may be encountered, due to springing. The pattern being in position it is covered with facing sand, and the joint is also well covered to ensure a good finish to the plate. All cods are tucked and rodded when necessary, after which the drag is placed on and filled to a depth of approximately 6 in. with floor sand, which is well trod to give an even firmness to the entire mould face and to eliminate the danger of hard spots, which are so often the cause of unsightly scabs.

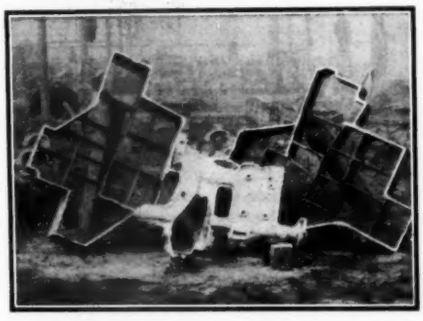

FIG. 1.—MOWER-FRAME CASTING, WITH PAIR OF SPECIAL BOXES.

Ramming.—The sand is well rammed, care being taken to keep well to the outside of the drag to avoid ramming immediately over the pattern. Following this the drag is filled and rammed over its entire area; in doing so, care must be taken to avoid the striking of the rods previously inserted. After flat ramming the mould is well vented. At this stage it should be stressed that it is important to have the drag marked with regard to the position of the cod of sand formed by the gear-box. This is done not only to ensure the cod being properly vented, but also to avoid the striking of the pattern. After venting, the box is turned over, placed on a bed, and the cope removed.

Jointing.—Extreme care is necessary in the preparation of the joint, as its contour and shape must correspond with that of the joint face of the boxes which are made specially for this pattern. The method used to determine the correct shape and contour is as follows. The two opposite ends of the plate are strickled off at a level corresponding with the centre-line of the barrel core prints and extending to the box edge. This ensures that both ends of the plate are on the same plane, as it is on these ends that the trunnions are fitted. Having done this, the remainder of the joint is strickled roughly into shape.

The next operation is to lower a special top part over the pattern until it rests on the joint, its position being located by the barrel core prints, which extend through each opposite end of the box. It is then gently knocked down until the ends touch the two sections that have been strickled previously. The special top part is now taken away, leaving the correct impression of the joint line. This is carefully followed, and the shape extended well beyond the outside of the line, for it counteracts to a large extent the discrepancies that arise due to contraction. When jointing has been completed, any section that is considered delicate is strengthened by sprigging, after which it is covered with parting sand and the pattern lightly rapped to facilitate its removal, together with the cope. The joint is then covered with facing sand and the cope placed on. Runners are placed in position, one in each corner of the box, this being necessary to facilitate pouring, as only hand shanks are available.

Liftering.—The lifters are interlocked to obviate any risk of sagging when the cope is lifted off, afterwards being covered and carefully tucked. The cope is then rammed up and lifted off.

Finishing the bottom half of the mould is the next stage, following which steel strips are placed round the outside of the mould, the top edge standing the thickness of the plate higher than the joint. After marking out the shape of the plate, the joint is built up by means of small strips. The pattern is then drawn, and the top half finished, after which the mould is closed and prepared for pouring. The casting and boxes are shown in Fig. 1.

End Cover

This casting, which was made in dry sand, presented several difficulties to the foundry concerned. In the first place, there was no moulding box available large enough to take the pattern, which is approximately 6 ft. diameter and 3 ft. 6 in. deep (Fig. 2). Secondly, the height of the overhead crane was insufficient to turn over such a large box. In view of these difficulties, the alternative of "bedding in" was resorted to, the following being a brief description of the method adopted. To simplify the operation it was decided to make a mould of the centre section of the pattern and dry it in the stove. This was made in a three-part box, the part resting on the face of the pattern comprising four sections bolted together, the object of this arrangement being to facilitate its removal. After the mould had been dried, it was lowered into a pit, the correct depth of which was ascertained by laying a straight edge across at floor level and measuring the distance from the strip to the mould face in several places (Fig. 3). The lower half of the centre mould was then rammed up and the sectional frame removed. At this stage a coke bed was laid and connected to the layer of coke in the centre mould; it also extended sufficiently far to ensure the vent pipes being clear of the top part. Following this the centre mould was rammed up to the top, afterwards venting the whole area to be covered by the pattern. After placing a bed of facing sand around the centre mould the pattern was lowered in position and firmly bedded. Ramming under the pattern was the next operation, following

* Paper read before the East Midlands Branch of the Institute of British Foundrymen, Mr. H. Bunting presiding.

which facing sand was placed round the pattern and the mould rammed up to joint level. From this point the making of the mould was completed in the usual way, and, after finishing, was dried by means of portable driers (Figs. 4 and 5).

Road Wheel

This example is a road wheel, its diameter being 32 in., the centre boss and outer rim are of cast iron, and the spokes are of " H " section steel, these being cast in. The chief trouble encountered in the production of this casting was the cracking of the outer rim, due to contraction stresses. This difficulty was successfully overcome by casting the outer rim approximately 20 minutes before the centre, thereby allowing the rim freedom to contract, and in doing so, to press the steel spokes further into the centre. Although the full contraction may not take place in the time allowed to elapse, that which takes place afterwards is fairly consistent with the contraction of the centre. The castings shown in Fig. 6 were free from internal strain.

Air-Cooled Cylinder

Although it is quite possible to produce this type of casting in green sand, nevertheless the practice of dried moulds meets with a greater measure of success. The principal trouble encountered when the casting was made in green sand was the blowing of the cooling fins, and after several experiments, which resulted in varying degrees of success, it was decided to dry the moulds and cast them vertically, the skirt of the cylinder being at the top. This method not only ensured the soundness of the cooling fins, but also resulted in a greater improvement in soundness and freedom from blowholes in the bore. Fig. 7 shows the complete mould together with a casting and illustrates the method of running.

Cylinder Head

This cylinder-head casting presented no difficulties from the moulding standpoint, but, as is common with most castings of this type, soundness is of paramount importance. To achieve this it is often necessary to resort to chills or denseners. Although they are an evil to be avoided if possible, on account of their liability to cause blowholes or chilled shot in machined faces, nevertheless they often provide the only means of preventing porosity in heavy sections if machinability is to be maintained in the lighter sections. Fig. 8 is an illustration of their application and their effect in producing soundness in heavy sections.

Twin Diesel Cylinder Blocks

Although it is common practice to dry moulds for this type of casting, this example weighing approximately 3 cwts. was made in green sand, owing to its complicated design. Some difficulty was experienced in the selection of the position of runners.

In the first place the joint presented few possibilities, as the mould was nearly 2 ft. deep, and from the standpoint of scabbing was regarded as too dangerous, and as the available space in the crankcase was very restricted, it was decided to ram two slot-runners in the central web core, their positions being diagonally opposite. One reason for this was to ensure an even distribution of metal; a second to facilitate pouring. This method has proved to be quite satisfactory in the production of a large number of these castings. Another trouble encountered was blowholes on the top face of the casting; these were not disclosed until after machining, and were usually found on the face of the heavy bearings at each end of the cylinder. To overcome this a dummy riser was placed each side of the two end bearings, and the pouring temperature was increased. These precautions had a marked effect, the castings afterwards being quite sound and free from blowholes after machining. Fig. 9 shows the cylinder-block casting complete with runners and risers, and also a casting after machining.

FIG. 2.—PATTERN FOR END COVER, WITH GROUP OF DENSENERS. THE WEIGHT OF THE CASTING WAS 50 CWTS.

FIG. 3.—CENTRE MOULD FOR END COVER IN POSITION IN PIT. NOTE RING OF DENSENERS IN CENTRE.

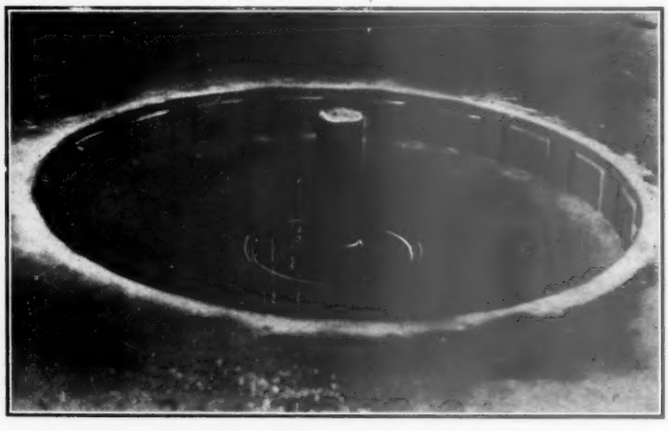

FIG. 4.—BOTTOM HALF MOULD FOR END COVER BEFORE CLOSING.

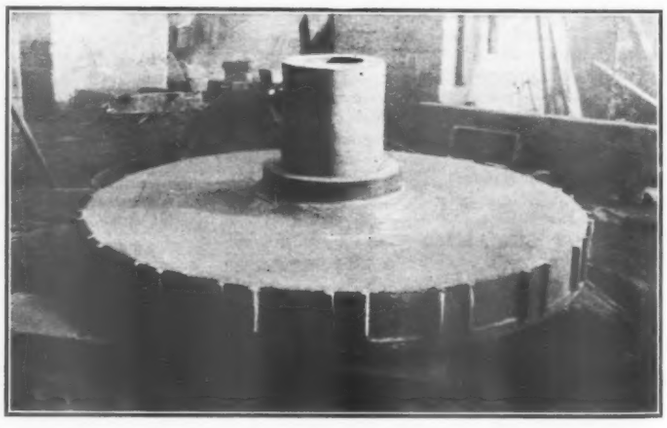

FIG. 5.—BOTTOM VIEW OF FINISHED END-COVER CASTING.

In conclusion, the author wishes to express his thanks to the directors of Bamfords, Limited, for their permission to use their patterns for the purpose of this Paper, and also to Mr. Bunting, who was responsible for providing one of the examples.

DISCUSSION

MR. R. H. BUCKLAND said he himself had seen a few cast plates made, and imagined that the example given was unique. To a certain extent, he considered that Mr. Butters and his foundry were very fortunate in the fact that they were making castings for their own machinery, and were able to make complete equipment to produce their own castings. Many foundrymen had to put up with designers wanting a certain casting one week, whilst the following week they would require something entirely different. Referring to the manufacture of road wheels, he

asked if the spokes were coated with any material, such as plumbago or French chalk.

MR. BUTTERS said the wheel spokes were treated, where they entered the casting, with red lead and turpentine, mixed to a consistency of thin paint.

Modern Inspection Methods

MR. T. GOODWIN asked the author to enlarge on the point regarding the making of the pattern plate. From the way in which it had been illustrated, it appeared that the box parts were made first, and he would like to know if this

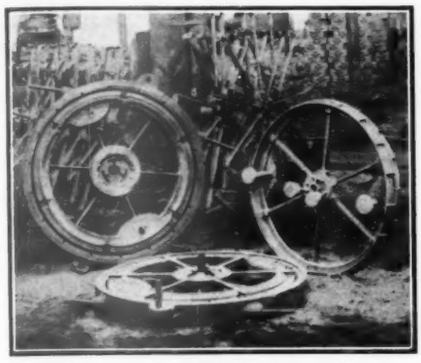

FIG. 6.—TOP AND BOTTOM MOULDS FOR ROAD WHEEL, WITH CASTING ON RIGHT.

was usual. Regarding cylinder work, which was always tricky work requiring much careful thought, Mr. Goodwin referred to one of his own experiences. He had to make a fairly heavy type of twin cylinder, and a margin tolerance was given. In one case the analysis of the metal was correct, the cylinders had machined splendidly and had withstood the water test, but when they reached the final inspection a very powerful light was played upon the bore. It revealed a patch about 1½ in. long where the grain of the metal was a little larger, and for that reason they were rejected.

MR. BUTTERS, referring to box parts, agreed with Mr. Buckland that they were fortunate in making castings for themselves. In the course

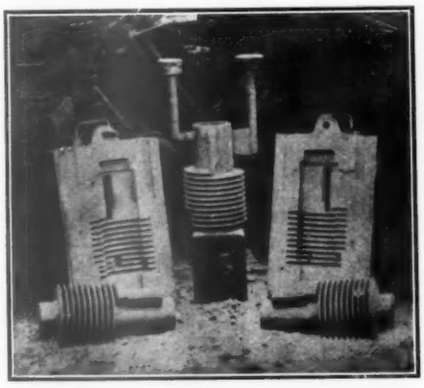

FIG 7.—PAIR OF MOULDS FOR AIR-COOLED CYLINDER, WITH PATTERNS IN FRONT AND CASTING IN CENTRE.

of six months, however, those boxes might be scrapped. Alterations might be found necessary during a season which necessitated a new box. The boxes when made were placed on a table in the patternshop and were fitted up and a wooden box part built round them.

Facing Sand Troubles

MR. J. C. HALLAMORE said he was interested in the casting with three runners in the centre. It had been stated that the casting was fed down one of them. Had the author had any experience of the other runners taking away the pressure of the feeder? He had cast a bush-shaped casting, weighing just under 1 cwt., with a rather fine screw thread in the centre. That one casting was run from the bottom, with two risers. It was fed down one only. The one which was fed was porous, whereas the other one was solid. To overcome that difficulty, they ran it from the bottom again, and put on one medium-sized riser which proved perfectly satisfactory. Another point was the sand used for air-cooled cylinder moulds. It appeared to him, when using an ordinary facing sand, that it did not dry well. He asked Mr. Butters if he made any slight alteration in sand at all, or was it ordinary green sand? He often found that, when the usual facing sand was used, without the addition of a little opening material, the mould crumbled very badly when dried. The chills on the cores were interesting, and he would like to know whether the chill shown was a thin or a thick chill. Referring to a 3-cwt. cylinder, Mr. Butters had mentioned the provision of a riser with an extra feed head, on top of the thick bearing, which gave porosity trouble. He would like to know if those castings were satisfactory without any riser.

MR. BUTTERS said they had tried the 3-cwt. cylinders with risers, and sometimes had small blowholes, probably two or three, in the face of a casting. That suggested that the metal was getting a film over it and trapping gas. Providing a riser over it seemed to aggravate the trouble where they were drilled at the bottom of the hole. They came out spongy, and it was difficult to put a thread on spongy metal. For that reason, they stopped running the riser through, and only a dummy riser was used, which seemed to cure the trouble.

Referring to the alteration in facing sand mixture for air-cooled cylinders, Mr. Butters said a standard mixture of sand, which usually was used for gear wheels, was employed. He had made the cylinders in oil sand, but a better skin was obtained on the casting by using ordinary facing sand.

In reply to Mr. Hallamore's question on feeding, he thought this had been proved by Mr. Hallamore himself, and that the trouble must have been poor feeding in the first place. Mr. Butters stated that the chills shown were hollow, the metal section being ⅜ in.

Sand Mixtures

MR. C. D. POLLARD asked what really did happen in the feeding of iron castings. He felt a little disappointed that the author had not given correct sand mixtures. It was stated that the majority of the work was done in green sand, and he would like to know the moisture content.

MR. BUTTERS said he had considered sand mixtures to be beyond the scope of the Paper. Only three mixtures of sand were used. The type for lighter castings was 2 per cent. coal-dust, 5 per cent. new sand and 93 per cent. black sand, put through a "Simpson" mixer. For all the heavier castings, an ordinary strong sand made up of 7 per cent. coal-dust, 10 per cent. new sand and 83 per cent. black sand was used. They never took any moisture test, other than the old method of feeling with the hand, but he would say the moisture content of the sand was around 6 per cent.

Mr. Pollard had asked why they fed, and the reason was that a heavy mass of metal had to be fed before it solidified. If there were not ample provision for feeding, the metal would feed itself and leave a drawn casting. It was useless to put a 1-in. feeder on a 4-in. boss, because the feeder would set long before the boss. The aim was to keep the metal alive immediately beneath the feeder. In his own works he did not use rod feeding; with a very heavy boss, an iron core was substituted, to act as a densener.

Rod Feeding

MR. POLLARD said he was interested to hear Mr. Butters say he did not use a rod, because he was about the first iron-casting producer who had said that.

MR. BUTTERS pointed out that they had not practised rod feeding because of the fact that, where moulding machines were producing 24 to 30 flywheels a day, a regiment of men would be required to stand round the flywheels to feed them.

MR. DUNLEAVY suggested that there were occasions in general practice when rod feeding was essential. He had always understood that the aim was to prevent a crust forming on the top of the metal. A blowhole could be caused through wet sand, a hard core, damp chills, or

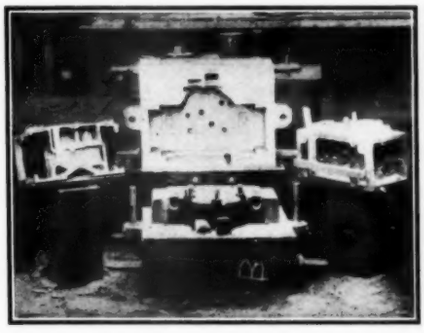

FIG. 8.—MOULD FOR CYLINDER HEAD, READY FOR CLOSING, WITH CASTING ON RIGHT AND SECTIONED CASTING ON LEFT.

the vents being blocked. A number of blowholes from chills were due to lack of dressing; an ordinary cheap dressing would mask a lot. If the chills were not dry, they would blow. So much was heard of blowholes that they really ought to have some definition of what a blowhole was. Statements had been made that a broken core or an airlock were blowholes, but that was not so. If the metal was too "stiff," it should be taken away, or the core, if not dry, be sent back.

MR. BUTTERS said, when one had a matter of seven chills in a mould, the metal would rise to the top; it would not rise as quickly as it would in a sand mould. There would be a certain amount of turbulence in a mould with a number of chills, whether dry or not.

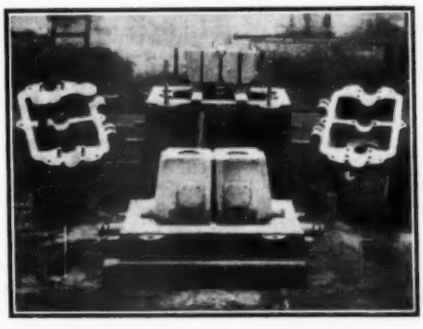

FIG. 9.—MOULD FOR TWIN DIESEL CYLINDER BLOCK, WITH CASTING COMPLETE WITH RUNNERS AND RISERS ON LEFT, AND A CASTING AFTER MACHINING ON RIGHT.

Chill Treatment

MR. DUNLEAVY suggested that if the chills were dabbed over with a whiting, that would absorb the moisture in the chill.

MR. B. HIRD, referring to the statement that a blow could not be got off a cast-iron chill, warned everyone that they could definitely get a blow. The safest practice with chills was never to use them more than once. All iron or steel, whatever was inserted in the moulds, contained gas, and, when raised to a certain temperature,

that metal would give off gas; the point was that, if the metal still remained liquid, one would almost certainly get a blowhole. Feeding was an interesting point. Rod feeding was almost an art, and, if it were not done properly, would cause more harm than good. Its object was to keep the connection between the riser and the casting metal open, so that the metal could feed itself. The way to feed with a rod was definitely to keep the rod moving round the outside of the runner hole. He agreed that the less a rod was used, the safer it was.

Referring to the making of the pattern-plate, Mr. Hird said he had seen this job and thought it an excellent and creditable job. In certain cases, it was possible to make a cast-iron matching plate and mount the existing iron pattern on to it.

Blacking Mould Faces

MR. P. A. RUSSELL asked what Mr. Butters used for finish with dry-sand moulds. Did he have any difficulty with wet blacking causing uneven surfaces on his castings? He would like to elaborate one point with regard to sand mixtures. Mr. Butters had stated he used a 40 per cent. new-sand mixture for the air-cooled cylinders. The moisture could be added by liberal application with blacking. The ordinary green sand, particularly of the nature that Mr. Butters had spoken of, would not produce, to his mind, a satisfactory dry sand unless it was given extra moisture.

MR. BUTTERS stated that the mould was wet blacked with an air-gun to get an even black. In connection with the blacking that was used for the ordinary green-sand mould, very little at all was used in their foundry. No blacking was used on such castings as flywheels.

MR. P. A. RUSSELL asked if any sort of bond was made with the wet blacking.

MR. BUTTERS replied that the mixture of wet blacking had, up to recent weeks, been ordinary plumbago, water and a slight addition of a "semi-solid" core oil. Recently they had added a small amount of terra flake.

Distortion and Camber

MR. H. BUNTING asked what difficulties due to distortion were experienced in the manufacture of the pattern-plate, and what steps were taken to overcome contraction difficulties and distortion. A certain amount of treatment would be required to get a casting of the description given true to shape.

MR. BUTTERS said the point had been raised about camber, when making a pattern-plate. The pattern itself provided the pattern-plate with a certain amount of strength. Camber was put in to keep the plate straight.

MR. ARMITAGE asked, if the casting were to be bared, and the plate left covered, after it was cast, would it not overcome the cambering when making a mould.

MR. BUTTERS said they aimed at getting a true plate; if they had a straight pattern-plate, there was no trouble in getting straight castings.

MR. W. G. SMITH asked how Mr. Butters, if using no plumbago and a small amount of red sand, arrived at only 2 per cent. coal-dust to give a good finish to his light castings. His own experience was that 7 to 8 per cent. was necessary.

MR. BUTTERS replied that all the light castings were made from an ordinary red sand. The sand mixer had his own measuring instruments. There was 5 per cent. new sand and 2 per cent. coal-dust, and this gave a good finish.

Vote of Thanks

MR. A. E. PEACE, in proposing a vote of thanks, said that Mr. Butters had obviously been to a considerable amount of trouble to collect his samples, and had been very fortunate in finding such a number of interesting cases. There was one point which had been mentioned in connection with the use of denseners and the question of blowholes. It was a fact that iron would

(*Concluded in next column.*)

The Ceramic Society

AUTUMN MEETING IN LONDON

The autumn meeting of the Refractory Materials Section of the Ceramic Society was recently held in London, when various important Papers were read, some of which are summarised below.

Testing and Properties of Heat-Insulating Materials

By DR. A. H. JAY and L. LEE.

Tests are described which may be adopted to estimate the usefulness of insulating materials, and the properties of over 30 products are tabulated, including results on diatomite, fireclays, silica asbestos and mica.

The main properties for consideration are thermal conductivity, maximum safe temperature, and crushing strength. Special attention is drawn to "maximum safe temperature," which, after thermal conductivity, is the chief factor controlling the correct application of heat insulating materials. Maximum safe temperature might be defined as "the highest temperature a brick can withstand for a prolonged period without changing more than 1 per cent. linearly."

To insulate a furnace economically involves the estimation of possible heat savings. Such calculations give some idea of the type of insulating material which would be necessary in any particular case, and the properties of the insulating material desired can then be specified in detail, allowance being made for the minimum thickness the main refractory would reach owing to wearing away.

The authors found the thermal conductivity of commercial insulating bricks having a maximum safe temperature of not more than 1,000 deg. C. to be of the order of 1.0 B.T.U. The thermal conductivity of bricks having a maximum safe temperature of 1,000 deg. C. is of the order of 2.0 B.T.U.

Some Comments on the After-Contraction Test for Fireclay Bricks

By H. D. BENNIE.

The test of after-contraction or expansion has stood unaltered in the method of manipulation for many years and, so far as fireclay bricks are concerned, its value is unquestioned to date. The author suggests that the linear measurement of test pieces is insufficiently accurate to meet the requirements of modern industrial uses.

The refitting of the callipers after reheating—in carrying out the test—is found in practice to be subject to difficulty with certain types of fireclay brick.

(*a*) In the case of heavily-grogged bricks which are imperfectly bonded, the comparatively large grog grains sometimes move or suffer volume changes independently of the test-piece as a whole, and as a result it is found impossible to refit the callipers along the marked position.

(*b*) Fireclay bricks subject to "iron-spotting," either as fired or during test heating, may produce small local "bloats" due to intumescence of the iron spots, and if this occurs along the marked position it will not be possible to refit the callipers after test heating.

(*c*) Some fireclay bricks, although capable of passing the refractoriness and refractoriness-safety tests for Grade 1 material, are liable to suffer slight distortion under the test heating at 1,400 deg. for 2 hrs. Here also it will be impossible to refit the callipers accurately.

The author suggests that measurement of the volume of the test-piece, before and after test heating, would be more accurate than any linear measurement, and has devised a volumeter for the purpose. From the percentage volume change thus obtained, the percentage linear change is in most cases obtained by dividing it by three.

It is claimed that the proposed method would give reliable results in all the cases mentioned, and would also save time as the necessity for parallel grinding would be obviated. It is further possible, by weighing the tested specimens before and after heating, to ascertain any change in bulk density.

An X-Ray Survey of Refractories

By DR. A. H. JAY AND DR. J. H. CHESTERS.

Debye-Scherrer patterns are given for the following constituents of refractory materials: quartz, cristobalite, tridymite, magnesia, alumina, magnesium aluminate, chromite, mullite and fosterite.

Information regarding the size of crystals and the degree of preferred orientation has been obtained by the monochromatic pinhole method. Quartzites are found to vary greatly in the crystal size, both within a given sample and from one sample to another. On firing for one hour at 1,450 deg. C. they yield varying amounts of cristobalite, the amount of conversion increasing with the fineness of the crystals and the amount of impurity present.

Used silica bricks from open-hearth furnace roofs show marked crystal development, the cristobalite in the first zone and the tridymite in the second zone being about 0.01 cm. in dia., compared with less than 0.001 cm. in the unused brick. Coarse crystallinity was not found to be an essential feature of magnesia bricks of high-thermal shock resistance.

Chrome ores give patterns that are very characteristic of their source. With certain ores the pattern is so consistent and unlike that of any other ore examined that it can be used to identify the chrome ore employed in the manufacture of certain chrome-magnesite bricks after exposure to iron oxide confirms the previous suggestion that the bursting observed is due to solid-solution of magnesite in the isomorphous chromite. All the aluminium-silicate refractories examined show the presence of considerable amounts of mullite. The siliceous-fireclay bricks showed in addition a considerable amount of residual quartz and some cristobalite. The size of the mullite crystals is usually exceedingly small, but increases with heat-treatment.

The authors find that, while other methods may furnish similar results, the use of X-ray methods gives results which are less open to doubt.

Gas-Tight Sintered Aluminia Ware

By V. H. STOTT.

The preparation and properties of sintered alumina are outlined, followed by technical details of its preparation. It is pointed out that sintering, which is a process of crystal growth, takes place in oxides other than alumina, and in the future may be utilised for the production of large crystals of refractory material.

Sintered alumina sheaths have been found to protect thermocouples at 1,550 deg. C. to 1,600 deg. C. from contamination by metallic vapours when sheaths of other materials have failed. The electrical resistance of the materials is higher than that of all known alternatives except sintered beryllia. Other valuable properties include high-squatting point (Seger cone 42), great resistance to chemical action at all temperatures, great mechanical strength, very great hardness and resistance to abrasion, high-thermal conductivity, and translucency, besides impermeability to the gases already mentioned.

(*Concluded from previous column.*)

dissolve gas, and, maybe, when one chilled the metal by the use of denseners, there was an evolution of gas quicker than when casting in sand.

MR. H. J. BECK, seconding the vote of thanks, congratulated Mr. Butters upon his Paper.

MR. BUTTERS briefly acknowledged the vote of thanks.

Old and New Patterns and Patternmaking*

By H. S. W. BRITTAIN

Like most long established things, patterns are supposed not to be as good as they used to be, and often old moulders are heard to express a longing for the days when "patterns were patterns and not just rough lumps of wood." This point of view is worth examining, especially with regard to jobbing or loose patterns.

In the first place, there is an outstanding difference between an old pattern shop and a new one. The old pattern shop *might* have had a circular saw or a jig saw and a crude lathe, but certainly nothing more. Essentially it was a hand shop; everything which went to the finish of a pattern was done by hand, and craftsmanship in this way reached a very high level. With a competent workman a pattern was bound to be good, at least in the sense of "finish" if not of absolute accuracy.

To-day it is different; the accuracy is there but the "finish" which usually distinguishes a good pattern from an indifferent one is obtained by machinery, and it is questionable if the results can be as good; certainly they are not always as good.

Contrast the product of a planing machine with the work of a man who can use a hand plane. It is immediately obvious that the machine finish is marred by minute waves which considerably reduce the value of that finish for moulding purposes. These faults do not apply to the hand finish, but not many take the trouble to finish off machine work by hand.

The Bad Patternmakers' Friend

Then again, take the use of the sander, either type. With the best will in the world one cannot get the finish really necessary, especially on the end grain. Apparently, of course, the finish is good enough, but what has happened is that the crevices made by the sander have been filled with fine wood dust which often only becomes dislodged when the pattern has been in the sand, and afterwards presents a roughened or "furry" appearance which is not conducive to good moulds.

Pattern-Millers

Another machine which is creating as well as solving patternmaking problems is the pattern-miller. Here again accuracy and speed are easily obtainable but the finish usually leaves something to be desired. The solution is, of course, to finish off by hand such work as really demands it, but there is a great danger of this final polishing, so to speak, being omitted. Hence the complaints from the foundry.

Actually it means that what is obtained from the modern pattern shop with its high-speed planers, precision lathes, and universal millers, and the rest of the modern equipment, is speed and cheapness; and whenever a particularly fine finish is required, hand craftsmanship still holds the field.

Varnishing Patterns

Whilst on the subject of finish, something ought to be said about varnish. Probably someone will ask sarcastically "Why do they use varnish in a pattern shop to-day?" The patternmaker accepts the implied slur by admitting that a great deal too many patterns are sent to the foundry without varnish, usually because varnishing costs money, and the idea nowadays is not to spend much on jobbing patterns. Varnishing does not, of course, take the place of patternmaking, its function is to make a pattern last longer, and more particularly to help the moulder to get a cleaner "draw." For this purpose there is the choice of shellac varnishes, coloured to taste, or of enamel. Shellac is the commoner in use and generally is quite suitable. The enamel finish has the advantage of giving the better surface but the disadvantage of "chipping" more easily. Largely the choice is a matter of taste.

Timber

Another point which ought to be borne in mind is the question of yesterday's timber as compared with to-day's. There is no question whatever that timber, that is, the kinds used for patternmaking, *was* thoroughly and properly seasoned, and the patternmaker need have little doubt as to how it would behave under foundry conditions. To-day's timber, on the other hand, has the disadvantages of its manner of production. Instead of the old slow process of natural seasoning, one is confronted with the use of modern high-speed seasoning, which, whilst it produces timber which is usable, does not produce timber which is reliable for foundry work. There is no time here, of course, to go into a discussion of the various methods of seasoning. Most foundrymen, of course, will be aware that the old method was to stand the timber in racks and let it dry out slowly, with nothing to prevent the free current of air around it except a roof to keep off the rain. To-day both steam and hot air are used to hasten this process of drying out, with consequent over-drying and under-drying, the effects of which are either a hard dry skin and a pulpy interior, or an entirely "lifeless" timber. One last point about present-day timber is that one can now buy it almost any thickness, and there is no longer the old labour of cutting down 3-in. planks for everything. This, of course, has advantages.

Therefore, so far as making patterns for jobbing moulding is concerned, one must allow that the old men were in general turning out a better product than the man of to-day, partly, or perhaps mainly, because he had more time, and partly because his manner of working and the material which he worked were both more conducive to a really good pattern. The modern aim is for cheapness, and many times it must be paid for.

Patterns for Moulding Machines

Actually, of course, this jobbing patternmaking is only a section of the patternmaking that is done. Great headway has been made in other directions, and a new branch has sprung up which is definitely progressive in a way that the older people would never have appreciated. This is patternmaking for machines. Here, of course, the raw material is not always wood, and a new technique and new craftsmen have had to be achieved. The question in this phase of patternmaking is often far more involved and intricate than the one which the old patternmaker had to answer. First, there is the question of whether the pattern shall be in cast iron, in brass, in aluminium, in antimony alloy, in wood, in plaster, or in stone-like material; whether it shall be part of the plate or whether it shall be separate from it; whether it shall be a complete pattern set in stone-like material, or whether only projections shall be in metal and the bulk in "stone"; whether it shall be an aluminium plate with a wooden pattern superimposed, or an iron plate with some special type of pattern imposed. These and similar questions are the first things to be settled before even beginning to make the pattern, and a patternmaker in a shop needing this type of equipment needs to have a pretty sound knowledge of the behaviour of these various materials under actual working conditions before he can be regarded as competent.

Probably to some, much of this will seem like splitting hairs, but nobody who has been through a modern shop would hesitate to endorse these remarks. This, then, is the patternmaking which has made the greatest strides, and though to many of the older craftsmen it would not look like patternmaking at all, it is actually the patternmaking on which the greatest concentration will have to be made whenever a real effort is made to advance the position of the foundry.

Much could be said, of course, in the way of contrasting old methods of pattern fabrication with new, and probably not all the modern methods are really good, but these minor disputes have not a great deal of significance so far as settling the major issue is concerned. What really is required is an acceptance of the fact that engineers will no longer pay prices for jobbing patterns which will enable them to be turned out as pieces of woodworking art complete with extra fine finish and a mirror face. A modern patternshop has to remember that it is allowed only so much money with which to turn out a pattern, and no discussion of patternmaking has any value which does not take account of the amount of money there is to spend on the job.

* A Paper read before a meeting of the Sheffield Branch of the Institute of British Foundrymen, Professor Andrew presiding.

DISCUSSION

MR. J. ROXBURGH remarked that the author was quite prepared to admit that to-day they had to consider patternmaking from the economical aspect. There was no doubt that patterns were made in much less time to-day than they were in the days of hand patternmaking, and really, when all was said and done, if they took a one-off job the pattern made to-day served the purpose. One would not attempt to varnish a one-off pattern and so on, so really the economical aspect was rather important. Naturally, if they had to make a pattern for a repetition job they wanted the pattern to be as near perfect as possible, but there was one point that seemed to him to be rather important. To-day there were much heavier and larger castings being made than in the olden days, and the strength and construction of the pattern was something of vital importance. From that aspect probably the making of those large patterns represented some line of progress as well as in the other direction. Engineers, due to the fact that cast iron could be made with much higher strengths to-day than hitherto, had gone to the extent of reducing the thicknesses, and therefore, as they all knew, there was really more accuracy attained from the patternmaking point of view.

MR. BRITTAIN, in reply, repeated that to-day more accuracy was obtained but probably the "finish" was more crude than it was years ago when the man had to do practically everything by hand. There was no doubt about it that patternmakers to-day left their patterns just as they came off the machines, unless they were dealing with anything for which a particularly good pattern was required. He was not necessarily saying that the old time craftsmen were better than the present ones, but the patternmaker to-day did not practice the art of using his hands.

Steel at the Empire Exhibition

The steel industry will be well represented at the Empire Exhibition at Glasgow next year. The pavilion in which it is being housed will have its own cinema, seating almost 250, in which films illustrating the story of steel will be screened. It is being erected by William Beardmore & Company, Limited and Colvilles, Limited. The exhibits, including several elaborate working models, will depict various manufacturing processes. The pavilion will stand on the hillside, facing south, below the 300-ft. tower. It will be flanked on the left by the South Cascades, and in the foreground will be the Palace of Engineering and the 400-ft. ornamental lake. The building has been designed with an imposing entrance hall measuring 44 ft. by 31 ft. Above it rises a tower 65 ft. high, from which spread the main "wings." At the rear are offices and reception rooms.

Patternmaking for Production Moulding

EAST MIDLAND FOUNDRYMEN'S DISCUSSION

The discussion on Mr. S. A. Horton's Paper, "Patternmaking for Production Moulding,"* which was presented to the East Midlands Branch of the Institute of British Foundrymen, was opened by the BRANCH-PRESIDENT (Mr. W. T. Evans), who remarked that Mr. Horton had given the members a very full Paper, illustrated by many examples. The author's method of building a pattern of hardwood and facing it with metal resulted in a lighter pattern, which made it easier for the moulder to get a good clean draw. A pattern must be of reasonable weight.

MR. A. E. PEACE said he did not think Mr. Horton had referred to aluminium pattern-plates. Mr. Peace had seen these used, and it occurred to him that they would reduce the weight. Was there any serious objection to aluminium pattern-plates? He knew that corrosion was a problem. A pattern with a number of fingers on it had been shown. Had those fingers been made in brass or wood? If made in wood they would be very weak, he imagined. In connection with coreboxes for core-blowing machines, and the method of quick removal by a wedge, Mr. Peace said he had seen a method adopted, where stiff wire, or rod, was used, which was snapped over and sprung. Had Mr. Horton any comments on that method?

MR. HORTON, referring to aluminium pattern-plates, said it would certainly be advantageous if one could have such pattern-plates, but there was the obstacle of cost. In production moulding it was a great advantage in reducing weight. As to the plate-pattern with fingers around the outside, the lecturer pointed out that a master pattern had been made of the small fingers, and they were cast in brass and secured in their correct position around the plate. He doubted whether wire clips for coreboxes would be a success on core-blowing machines, because a very tight joint was essential, or sand would escape through the joint.

MR. F. DUNLEAVY said that the current impression that the patternmaker was there to construct, and the moulder to destruct, was wrong. The skilled moulder did not misuse patterns, and he would like to have Mr. Horton's assurance that the damage referred to was done by unskilled or semi-skilled workers who did not appreciate the value of patterns. He asked Mr. Horton if all the castings illustrated were malleable. A few years ago he made a pipe 7 ft. 6 in. long, and used a plain board, the shape of the pipe, and strickles. That would be a far better and cheaper way than the method which had been shown on the screen.

MR. HORTON agreed that his foundry in general was dealing with semi-skilled labour. Those were the conditions ruling in the foundry, and one had to impose conditions suited to that foundry. He reminded Mr. Dunleavy that the Paper dealt with patternmaking for production moulding, and he considered his method for making a pipe core, which was for production moulding, far superior, and suitable for the conditions. For a one-off job, he agreed that the strickles would be fitted for the job. All the castings illustrated were of malleable iron.

MR. R. H. BUCKLAND was pleased to hear the view stressed that it was the "casting" which was required. Some patternmakers insisted that a pattern was right, yet a pattern often had to be made incorrect to make a casting right. He asked if Mr. Horton had any records relating to the number of castings made from hardwood patterns, as he believed it possible to obtain thousands of moulds from such patterns.

MR. HORTON said the number of castings produced from a hardwood pattern did run into thousands. On one particular job, they produced between 9,000 and 10,000 from this material. It was in production a long time and periodically was sent to the pattern shop to be renovated, or varnished. One section, which the moulder had continually brushed and painted over, was reduced by $\frac{3}{64}$ in.

Rapping Plates

MR. H. G. COCHRANE said he had hoped Mr. Horton would mention some kind of rapping plate. He thought that strong rapping plates were necessary.

MR. HORTON agreed that a number of patterns which were sent in would be much better constructed if the rapping plate was incorporated. Rapping plates were not used on production patterns, as these are generally vibrated by machine.

MR. F. BUTTERS considered a wooden pattern mounted on a wooden board was a frail thing to send into a foundry.

MR. HORTON replied that he had plates which had produced thousands of castings.

MR. C. D. POLLARD said a patternmaker was not a man who had to make something to look nice. He must know really more of the moulding side than the moulder himself. Unless a patternmaker, on receipt of a drawing, could visualise the moulding throughout, he could not usefully discuss that job with the foreman moulder. Mr. Pollard declared that, as a maker of steel castings, he much preferred properly-made hardwood patterns to metal patterns. They would last, providing they had proper use, for many thousands of castings.

MR. T. GOODWIN said Mr. Horton had shown them the better way to build a pattern, and how to make a corebox so that it would have a long life, as well as the easiest way to do it. Aluminium pattern-plates could be worked successfully, and for flask work they were ideal.

Pattern Compounds

MR. H. A. REDSHAW asked if the pattern compound expanded at all. When they made a mould from the pattern compound, was there any trouble with the mould, and did the pattern have to be eased at all? Referring to the box pattern of wood, faced with brass, he thought a metal pattern would have been better, and, in his opinion, it could be made just as quickly.

MR. HORTON said he had no experience of expansion of stone compound. Sometimes there was a sagging, but that was not actually due to the material, but to the mould into which the stone was poured. The box illustrated was lighter with a wooden base, and if made with a cast-iron section, a master pattern would have to be made first.

Patterns for Machine Moulding

MR. J. LUCAS pointed out that much had been said about metal pattern fitters. These operatives ought to be divided into two entirely different classes—metal pattern filers and metal pattern fitters. One class would be called semi-skilled, and the other skilled workers of the first order. Referring to hardwood patterns, in the course of many years' experience, Mr. Lucas had found these would last exceptionally well if properly made and adequately filleted, and would give good service in actual work. He had expected Mr. Horton to say something about machines of various types, for patterns nowadays had to be made to suit moulding machines. The author, he said, made a model of the casting he was going to produce, and from that model was made a plaster cast for the contour of his core, which he said gave perfect matching of core and mould. There might be a variation in the core, and several times he had noticed a core would turn out bigger than the corebox.

MR. HORTON said that the subject of patterns to suit various types of moulding machines was well worth a Paper. Regarding matching up of cores and moulds, one had to revert to the old system of trial and error, when trouble was due to variation in cores. In connection with cores which were bigger than the corebox, the lecturer said that when they had a core made and found a sag, this was allowed for; they provided extra depth of corebox to allow for that sag, and this again was a matter of trial and error.

Pattern Wear Control

MR. LEWIS asked whose job it was to control the wear of patterns in use.

MR. HORTON, in reply, observed that the moulder could not be relied upon to tell where the pattern was wearing, since it wore so slowly and was hardly noticeable. He suggested the return of patterns to the pattern shops periodically, where templates could be kept; it would be quite easy to run over the patterns to see whether they were worn or not.

MR. HOLLAND asked whether the cost of renovating a wooden pattern would not be more than making a metal pattern. By the time a complaint was received from a customer, many castings would be made and spoilt.

MR. HORTON pointed out that, when they were given a job, they did not always know how many castings would eventually have to be made. If a particular job was initially a rather small order, a wooden pattern was used. The difficulty arose when repeat orders came in, but this could be overcome by making a metal pattern when larger quantities were required.

MR. B. GALE referred to coreboxes on core-blowing machines, and said that one point not mentioned by Mr. Horton was the action of the compressed air and the sand on the corebox directly beneath the blowing hole. His experience was that one very quickly detected wear in that part of the corebox. He would like to know if Mr. Horton had any method of overcoming that trouble when making the corebox. He regretted that Mr. Horton had no experience of the question of the expansion of artificial stone. Mr. Gale had had cases with castings having very fine limits for location, and he had found that the entire pattern had grown. The growth might be only 0.010 to 0.015 in., but that was serious when on machine locations.

MR. HORTON agreed that the coreboxes on core-blowing machines did wear, but he knew of no definite method of preventing that wear. Regarding the stone compounds, he used them in a number of production pattern-plates without having any troubles due to variation.

Pattern-Plate Details

MR. P. A. RUSSELL said, from his experience, one frequently received customers' patterns which required duplicates. White-metal non-shrinking patterns were the best in such cases. He asked whether Mr. Horton had ever experimented with different types of aluminium alloys for pattern-plates. He would also like a few more details of the construction of pattern boards. Unless a pattern board was very accurately constructed, it would not keep its flatness; the size and number of battens were an important factor. When securing split metal patterns to plates, it was necessary to use screws and bolts; what method had Mr. Horton of filling up the screw heads, so that the marks were not obvious?

MR. HORTON agreed with Mr. Russell that there was no shrinkage with white metal. They could not use a pattern supplied to produce an aluminium pattern, and would have to use a master pattern. They very seldom made white-metal patterns. Regarding the filling of screw heads, for brass patterns the slots in screw heads were soldered over; for an aluminium pattern aluminium solder was used, and for the iron patterns wax was used for the screw head slots. A metal board was usually preferred for the building up of pattern-plates.

On the proposition of MR. NIVEN, seconded by MR. ORME, a hearty vote of thanks was accorded to the lecturer.

* FOUNDRY TRADE JOURNAL, November 18 & 25, 1937.

Alloying of Malleable Iron

By W. F. CHUBB, B.Sc.

As very little has been written on the subject of alloys in malleable iron, it is proposed in this article to review the position as completely as possible, and to show more clearly its relationships and advantages. At the same time, it is intended to include in an appropriate place the results of some original research work, recently completed and relating more particularly to molybdenum in malleable iron. This treatment of the subject will thus have the twofold advantage of clarifying the status of molybdenum and, at the same time, bringing existing knowledge up to date.

At the outset it must be said that such knowledge as exists is distributed widely through the technical Press, but when it is recalled that much of the knowledge in existence has been of a semi-private character, the imperative need for this review will be clear. It is accordingly hoped that the information here presented will stimulate interest sufficiently to lead to the development of alloyed malleable iron in appropriate directions.

General Properties

Malleable irons vary very considerably not only in composition, but in physical properties also. It is not the purpose of this article to make any attempt to account for these facts, but if satisfactory comparisons between alloyed and unalloyed irons are to be attempted, it raises at the outset one very interesting and important question, namely, "What may one regard as average properties in plain unalloyed malleable iron?" The answer to this will depend upon the type of malleable iron made, the method of manufacture, whether whiteheart or blackheart, whether made by the quick malleablising process, and upon a host of other relevant details.

Some of these questions are answered in the "Symposium on Malleable Iron Castings," published in 1931 as the joint work of the American Foundrymen's Association and the American Society of Testing Materials. For the air furnace and cupola products, the following properties were stated to be average.

(1) *Air-Furnace Malleable Iron (Blackheart).*

From a white iron which as cast contains 2.35 to 2.60 per cent. of carbon, a malleable iron of the following analysis can be made:—C, 1.00 to 2.00; Si, 0.60 to 1.10; Mn, 0.30 max.; S, 0.06 to 0.16; P, 0.20 per cent. max. The carbon content in the finished article varies somewhat between the limits mentioned, but such an iron is stated to have the following properties:—Tensile strength, 24.1 tons per sq. in.; yield point, 16.1 tons per sq. in.; elongation in 2 in., 18 per cent.; Brinell hardness, 115 (range 100-140); and modulus of elasticity, 25,000,000 lbs. per sq. in.

These figures represent average values for malleable iron of this type, but the above-mentioned report goes on to point out that, by lowering the total carbon content in the white iron to the limits 2.0 to 2.2 per cent., it is possible to produce malleable irons of higher tensile strength. To accomplish this, it is clearly imperative to operate under more closely controlled conditions, but when accomplished the following average properties may be expected:—Tensile strength, 25.4 tons per sq. in.; yield point, 17.0 tons per sq. in.; and elongation in 2 in., 23 per cent.

It is of interest to include here the demands of the British Standards Institution for malleable iron, since the influence of molybdenum in both blackheart and whiteheart iron will be more readily realised. Their requirements are for 20 tons per sq. in. minimum ultimate stress, with a minimum elongation of 7.5 per cent.

(2) *Cupola Melting.*

Since a fair proportion of white iron for malleablising purposes is made by the cupola method, it is necessary to give due consideration to irons of this type, and a white iron containing 2.50 to 3.00 per cent. of carbon may be regarded as typical. This, indeed, applies in the majority of cases, although special recommendations have been advanced to serve particular needs. After annealing in accordance with best blackheart practice, irons of this composition will give a malleable product with the following typical physical properties:—Tensile strength, 20.2 tons per sq. in.; yield point, 15.6 tons per sq. in., and elongation in 2 in., 7.2 per cent.

This *résumé* of the properties obtainable in unalloyed malleable iron emphasises the importance of the manufacturing method adopted, and furthermore, emphasises the significance of the base metal in this, as in all other applications of alloying additions. In showing the properties which normally may be expected in plain malleable iron, it will be appreciated that these average properties provide also a fair basis for gauging the influence of any particular alloy addition under review.

Objects of Alloying

It will clearly be in the minds of potential users to inquire what are the likely benefits of alloy additions to malleable iron. Many will have already gained experience in the manufacture as well as in the applications of alloy additions to ordinary grey iron, but in the case of malleable iron, its known limitations and advantages will give rise to a number of pertinent questions as to the use of alloying elements. Five such questions are likely to arise, namely:—

(1) Can the introduction of alloys to malleable iron shorten the usual annealing cycle?

(2) If the standard annealing treatment cannot be employed, what improvement in physical properties can be secured as compensation for the additional cost involved?

(3) If the annealing cycle can be shortened by any appreciable amount, is it possible to secure at the same time an improvement in properties?

(4) Do alloy additions improve the characteristics of original white-iron castings?

(5) What modifications, if any, in production methods, including annealing treatments, will be necessary for making alloyed malleable irons?

By reference to the results of some original researches recently completed, the present article will show how far molybdenum additions to malleable iron will answer the above queries. With this object in view, the subject will be studied under the three following headings:—(*a*) Alloy metallurgy of malleable iron; (*b*) physical properties of molybdenum malleable iron, and (*c*) foundry advantages of molybdenum malleable iron.

Alloy Metallurgy of Malleable Iron

In studying the alloy metallurgy of malleable iron, it must be recalled that there will be two main types of this material. The first type is that in which all the combined carbon of the original white iron has been dissociated completely. These irons are thus alloyed modifications of the blackheart variety, with physical properties determined by the type of alloying element added. In this instance, the alloy addition will occur in solid solution in the ferrite and the microstructures will show no fundamental differences when compared with those of ordinary unalloyed blackheart malleable.

In the second type of iron, in which a greater or lesser amount of carbon is retained in the combined form, dependent among other factors upon the temperature and time of annealing, the influence of the alloy will be of considerable importance. In this instance, its effects will be derived not so much through its solid solution characteristics but more through its effects on carbide stability, as well as through its influence on the phases retained on cooling through the critical transformation range. Thus a good deal will depend upon the nature of the addition element, and more particularly upon its mode of occurrence in the material.

The influence of the alloy addition to material of the first type must of necessity be somewhat narrow, for it can only be felt as far as its influence on the properties of ferrite is concerned. It cannot, of course, influence the physical properties of the temper carbon as such, but it could conceivably modify the properties of the whole alloy by its effects upon the size and distribution of the graphitic areas. Derived in this way, its influence would be indirect, and that this does occur in the case of nickel additions has been clearly established by Dr. F. Johnson in a research published in the Carnegie Scholarship Memoirs of 1931. In this research the author was privileged to take more than a passing interest, and to quote from the conclusions reached it may be stated that, so far as whiteheart malleable iron is concerned, "nickel is responsible for a diminution in the size of the temper carbon nodules, and, up to 2.8 per cent. of nickel, for a retardation in the rate of migration of carbon during annealing, thus leaving behind more combined carbon, which impairs the toughness and ductility of the bars."

Other researches on the influence of nickel have since been published. For example, H. Wentrup and W. Stenger ("Die Giesserei," 1931, Vol. 18, pp. 24-28) have recorded that in amounts up to 1 per cent., nickel is practically without effect, but that a 1.8 per cent. addition markedly accelerates the breakdown of iron carbide. They were unable, however, to observe any regular relationship between nickel content and cementite decomposition. Their researches also showed that chromium as low as 0.2 per cent. was sufficient to prevent breakdown of the carbide, and that whatever the chromium content, it was always possible to remove its restraining influence by suitable additions of nickel.

Results widely different from these have, however, been reported by J. V. Murray (Proc. Staff. I. & S.I., 1929-30, Vol. 45, pp. 40-44) in a study of the influence of nickel on whiteheart malleable iron. This report states that both cupola and crucible malleable irons give the best all-round properties with 1 per cent. of nickel. Above the amount stated the influence of this element is to increase further the tensile strength up to the limit of composition at which graphite makes its appearance, this increased strength coinciding with a refinement of the pearlite, more particularly at the core. A more homogeneous structure is claimed with the disappearance of the decarburised edge.

It will be seen that nickel and chromium offer examples of alloy additions which respectively promote and retard graphitisation. Aluminium is another element of the type which, like nickel, accelerates the decomposition of iron carbide. Thus, 0.08 per cent. of that metal is stated to increase both the strength and ductility, but above this limit each of these two properties, as well as the fluidity of the iron, are considerably reduced. This element is, indeed, a strong graphitising agent, as well as being a powerful deoxidiser, but in decomposing iron carbide, it possesses the very undesirable feature of causing graphite to separate in a coarse and angular form.

It will be clear that, from the very nature of the processes employed for manufacturing malleable iron, whether blackheart or whiteheart, a drastic limitation exists concerning the choice of suitable alloying additions. In the first place, it is essential that the iron as originally cast be white in fracture and, at least in the production of the blackheart variety, this white iron must be capable of being an-

nealed economically to give a structure in which all the combined carbon has been reduced to graphitic form.

From this discussion of the effects of aluminium, nickel, and chromium it will also be evident that alloying elements vary considerably in their effects on the retention of combined carbon on casting, and annealing experiments show further that these influences may be even more variable during the subsequent heat-treatment cycle. The influence of various alloying elements on the stability of iron carbide during casting and upon graphitisation during annealing has been well established, however, in the following order:—

1	2	3	4	5	6	7	8	9	10	11	12
Si	Al	Ni	Cu	Co	P	Mo	W	Mn	V	S	Cr
Promote graphitisation						Retard graphitisation					

Of these twelve elements, the first six promote graphitisation, and the remainder render carbides more stable during both casting and annealing.

This classification has been based primarily upon experiments conducted to determine the influence of each element on the temperature at which graphitisation begins, but the results so obtained have been verified also by annealing experiments, as well as by actual experiences during commercial annealing practice. From these experiments and experiences, however, there is no basis upon which it can be concluded that the mechanism by which graphitisation is promoted or retarded is similar for all the various elements in each category. To render this more clear, it may be recalled that the retardation of graphitisation by chromium is due to greatly increased stability of the chromium carbides formed during alloying. Sulphur is another element which favours the retention of carbon in the combined form, but it will be clear that the influence of sulphur in retarding graphitisation during annealing must be due to an entirely different mechanism. As far as molybdenum additions are concerned, the retardation of graphitisation which results is thought by some authorities to be caused more by sluggishness of transformation than by any inherent stability of molybdenum carbide.

Hence, in the above classification the first three, namely, silicon, aluminium, and nickel, are those which can complicate the problem of obtaining white-iron castings free from primary graphite, and the last three, namely, vanadium, sulphur, and chromium, though providing satisfactory white-iron castings, are those which cause difficulties in subsequent annealing from the causes previously outlined. Even manganese, which at one time was thought to offer opportunities as an alloying addition, has so far proved a disappointment, for when present in amounts above 10 per cent., it retards graphitisation to such an extent as to preclude its use.

The above considerations thus suggest that copper, molybdenum and tungsten will be the most desirable additions from the manufacturing standpoint. Of these three elements, little is known as to the influence of tungsten on malleable iron, but copper has certain limited possibilities in engineering applications. It is not proposed to deal here with the influence of copper in malleable iron, as this subject has been admirably covered by Sallitt in THE FOUNDRY TRADE JOURNAL quite recently.

In order to appreciate fully the properties of alloy malleable iron, it is necessary to recall that there exist two major differences between the blackheart material and pure iron. Firstly, malleable iron in its unalloyed conditions must contain silicon as an essential constituent in amounts up to 1 per cent. This element is present in solid solution, and in this form it is not without an appreciable influence upon the mechanical properties. Thus, if the tensile strength of pure iron be regarded as approximately 18 tons per sq. in. and its yield point and elongation are respectively 9 tons per sq. in. and 50 per cent., the silicon in solid solution will bring about the following modifications in properties, the figures quoted being based upon actual measurements:—

(*a*) Tensile strength will increase by 2.25 to 6.75 tons.

(*b*) Yield point will increase by 4.5 to 9.0 tons.

(*c*) Elongation will decrease by 25 to 45 per cent. of the original value.

(*d*) Accompanying these changes will be found an increase in the Brinell hardness of from 30 to 50 units.

The second difference lies in the fact that this solid solution of silicon in iron is interspersed with nodules of temper carbon formed by decomposition of iron carbide. The discontinuities of structure which result will not be without their influence on mechanical properties.

To derive the fullest effects from silicon additions, certain alterations in composition must be undertaken. Thus, the use of lower carbon contents will permit of higher silicon, and this practice is reflected in the so-called high strength malleable irons. The use of a lower total carbon content may in some instances, however, be objectionable from a foundry standpoint.

(To be continued.)

Prevention of Silicosis by Metallic Aluminium

Before a recent meeting of the Academy of Medicine, Toronto, J. J. DENNY, W. D. ROBSON and D. A. IRWIN read a Paper on the prevention of silicosis by metallic aluminium. The research formed part of the investigations started in 1932 at the McIntyre Porcupine Mine, in Ontario. It was discovered at this mine that the presence of small amounts of metallic aluminium almost completely prevented siliceous material from passing into solution. This discovery was made after investigating Heffernan's theory that silica is active when freshly fractured, because of its molecular structure, which presents numerous unsatisfied oxygen atoms to interact with tissue elements. This suggested to the authors that if the unsatisfied oxygen atoms could be satisfied with nascent hydrogen it might diminish the toxicity of silica in tissue and change a fibrotic response into a simple foreign body reaction.

Animal experimentation was commenced in 1936, and the results showed that silicosis was inhibited in a small group of rabbits by the admixture of less than 1 per cent. of metallic aluminium to the quartz dust. Dusting experiments similar to the one described above are being carried on at the present time, using larger groups of animals. From this group, following 3½ months' dusting, the lungs of one quartz control and two quartz and aluminium dusted animals were sectioned. The lungs of the control animal showed beginning silicosis, while the two animals dusted with quartz and 1 per cent. aluminium showed no evidence of any fibrosis.

In discussing the results, the authors pointed out that other investigators seem to have apparently overlooked the importance of the impurities contained in quartz or other siliceous material as being a causative factor in the production of silicosis. It has been found that the alkaline earth carbonates, or carbonates in chemical combination with metals that may be easily decomposed, are responsible for the increased solubility of siliceous material. The solubility of quartz is increased by the presence of small amounts of the carbonates and hydroxides of magnesium, sodium, potassium and calcium. The solubility of quartz is reduced by large amounts of calcium hydroxide, but is entirely dependent on the strongly alkaline reaction. Further animal experimentation has been under way for some months, both at the McIntyre Mine and the Department of Medical Research, Banting Institute, the latter using large groups of rabbits, guinea pigs, cats and dogs.

Inert Atmospheres in Furnaces

MR. ERNEST E. THUM (Editor, "Metal Progress"), in the course of an article in that journal on "Preparation of Furnace Gases for Non-Oxidising Atmospheres," gives the following suggestions for overcoming the presence of oxygen in furnace atmospheres.

Oxygen can be removed from the air by liquifying air, then putting it through a process of fractional distillation, withdrawing therefrom the relatively pure nitrogen and supplying it to the furnace. However, this method of making nitrogen, although it is commercial, requires a rather costly plant, and the gas would probably come to about £2 per thousand cub. ft.

While pure nitrogen serves admirably as an inert atmosphere, it has nothing in it to counteract any leak in the muffle or consume oxygen introduced with the cold metal adsorbed on its surface, or even in light oxide layers on the metal. Therefore, a little hydrogen would be ordinarily added to pure nitrogen to react with such oxygen.

Hence one turns to the more useful mixtures of nitrogen and hydrogen gases. In them hydrogen is ordinarily kept fairly low in percentage because it is considerably more costly than the nitrogen, and, furthermore, rich hydrogen mixtures introduce an explosion hazard.

A very good source of the nitrogen-hydrogen atmospheres is anhydrous ammonia (NH_3), available in quantity, and which can readily be dissociated in simple, compact equipment to a mixture of 75 per cent. hydrogen and 25 per cent. nitrogen very low in water vapour. However, it costs approximately 17s. 6d. per thousand cub. ft., and therefore is usually limited to small or special work in furnaces where there is very small wastage.

It has been said that pure hydrogen will decarburise steel at heat-treating temperature, especially if it contains a little water vapour, and it is almost impossible to keep such an atmosphere free of water vapour because a little oxygen is likely to come in from a leaky muffle, through the charging door, or from reduced oxides or scale.

An obvious way to prepare a protective gas is to start with a gaseous fuel, which may be regarded a mixture of simple hydrocarbons. For low-temperature work the raw gas might be used, were it not that its combustibility would introduce definite hazards, and also that several volumes of suitable gas can be prepared from one volume of fuel gas at small additional cost. Complete equipment is available for the conversion of methane, propane or natural gas to nitrogen-hydrogen atmospheres ranging from 7 per cent. up to 14 per cent. hydrogen.

Dorman, Long Steel Output

Mr. J. G. Goodenough, director of Dorman, Long & Company, Limited, replying to comments on the company's rearmament work and dividend proposals, said that, so far as it applied to his firm, the statement that the big demand for steel was due to armament work was not correct. An analysis of their output for the past twelve months showed that only 10 per cent. was a direct result of the Government's rearmament policy. In the year ended September 30 last, Dorman, Long had mined 3,300,000 tons of coal from their collieries, manufactured 1,250,000 tons of pig-iron and 1,500,000 tons of steel ingots. There had been record outputs almost every week, and they now employed just under 40,000 men. Referring to the criticism that the 10 per cent. dividend was not big enough in view of the profits earned, Mr. Goodenough said:—"We think that the best insurance for all workers in terms of employment is the provision of adequate sums towards the reserve."

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The Week's News in Brief

Trade Talk

THE WOLVERHAMPTON DIE-CASTING COMPANY, LIMITED, is to be converted into a public company.

THE CONSETT IRON COMPANY, LIMITED, is preparing to put into operation another blast furnace.

HUGHES BOLCKOW SHIPBREAKING COMPANY, LIMITED, Blyth, have bought for breaking-up the liner "Lutecia" (14,000 tons).

THOMAS FIRTH & JOHN BROWN, LIMITED, the Sheffield steelmakers, celebrate the centenary of the founding of the business this year.

A PARTY OF MEMBERS of The Institute of Vitreous Enamellers paid a visit to the works of Steatite & Porcelain Products, Limited, at Stourport-on-Severn, to-day (Thursday).

J. P. HALL & SONS, LIMITED, engineers, of Peterborough, are adding two new bays to their premises, in consequence of increased work. Each bay measures 120 ft. by 25 ft.

ALUMINIUM-ALLOY FUNNELS are to be fitted to the Cunard White Star liner "Mauretania," of 30,000 tons, now under construction by Cammell Laird & Company, Limited, at Birkenhead.

THE NEW metal works established at Jarrow by Sir John Jarvis, in the old boiler shops of the former Palmers' Shipbuilding & Iron Company, Limited, was brought into production on Monday.

KEITH BLACKMAN, LIMITED, engineers and manufacturers of volume and pressure fans, etc., report that substantial progress has been made with the erection of the new works at Tottenham, and it is anticipated that production will start in the first section of the factory early in the New Year.

RAIN HAS FALLEN at last in the Kinlochleven area, where, owing to the dearth of water, it had been impossible to work the plant at the factory belonging to the British Aluminium Company, Limited. The level of the Blackwater reservoir, the source of the factory's water supply, has risen to about 4 ft. The normal height at this time of year, however, is about 60 ft.

THE FOLLOWING GENTLEMEN have joined the Governing Body of the British Foundry School:—Mr. E. Bowen (W. & T. Avery, Limited); Mr. J. F. Davies (managing director, John Wright & Company, Limited (Radiation, Limited)); Mr. A. McKinstry (managing director, Babcock & Wilcox, Limited), and Mr. W. A. Stanier (chief mechanical engineer, London Midland & Scottish Railway Company).

A FIRM which will trade under the name of Scottish Alloys, Limited, has secured the lease for a factory in the new industrial estate at Hillington, Glasgow. The company's products will include high-duty non-ferrous alloys, and die-castings in brass, bronze, aluminium and zinc. There will also be a fully-equipped non-ferrous sand foundry. Production is expected to begin early in the New Year, when employment for about 300 will be provided.

A CAST-IRON SHIP'S PROPELLER, weighing 19½ tons, and cast in a single piece, has recently been completed by Smith & Company (South Shields), Limited, at the Holborn Foundry, South Shields. It is 19 ft. 6 in. in diameter, with four blades each 6 ft. wide, and has a surface area of 143 sq. ft. The boss is 3 ft. 8 in. long and 3 ft. 6 in. diameter. It is believed that this propeller, which is to be shipped abroad, is the largest and heaviest ever made as a single casting. Smith & Company are also undertaking the manufacture of a second propeller to act as a spare for the same ship.

Cupola Practice in Textile Engineering Works

Mr. John Jackson, author of the Paper bearing the above title, which was printed in the JOURNAL last week, draws our attention to the following errors and alterations:—The size of the bottom tuyeres, given on page 434, first column, under the heading "General Particulars," should read 6¼ in. by 4 in. (instead of 4¼ in. by 4 in.). At the foot of the same page, under "Cupola Linings," it is stated that "every cupola in regular blast required rebricking from the charging hole to the hearth every 12 to 18 hours"; this should, of course, be 12 to 18 months. On page 436, under "Annealing Iron Castings," the first sentence should read: "In a normal week's work . . . 320,000 to 600,000 of the castings produced are annealed, etc."

Personal

MR. SYDNEY SIMPSON, of the Taikoo Dockyard & Engineering Company of Hong Kong, Limited, is at present in England on leave. His home address is Linton, Mount View Terrace, Stocksfield, Northumberland.

MR. F. R. HOADLEY, of the Atwood Machine Company, Stonington, Conn., and Mr. W. D. Hamerstadt, of the Rockwood Manufacturing Company of Indianapolis, have been re-elected President and Vice-President respectively of the (American) National Founders' Association.

MR. GEORGE B. WATERHOUSE, Professor of Metallurgical Production at the Massachusetts Institute of Technology, and President of the American Society of Metals, has been awarded the honorary degree of Doctor of Metallurgy by the University of Sheffield, in recognition of distinguished work in iron and steel research.

MR. W. B. PICKERING, a former President of the Sheffield Chamber of Commerce and a director of Hadfields, Limited, has been elected chairman of the Sheffield district branch of the Federation of British Industries. He succeeds Mr. F. C. Fairholme, a former managing director of Thos. Firth & John Brown, Limited, who has been chairman of the branch for twelve years.

Obituary

MR. EDWARD DUNLOP, a director of Fleming & Ferguson, Limited, engineers and shipbuilders, of Paisley, died on Saturday at the age of 69. He was recognised as one of the foremost marine engineers on Clydeside.

MR. JOHN L. SHARPE, secretary of Stewarts and Lloyds of South Africa, has died, aged 47. Mr. Sharpe, a native of Coatbridge, Lanarkshire, served 34 years with Stewarts and Lloyds, Limited, first in Coatbridge, and for the last twelve years at Vereeniging.

WE REGRET to announce the death of Mr. William George Dauncey, President of the Shawinigan Foundries, Limited, Canada, at the age of 73. A native of Walsall, Mr. Dauncey spent much of his life in Australia and New Zealand, but from 1914 he had been prominently associated with Canadian foundry developments.

THE DEATH has occurred at Grangemouth of Mr. John Dick, aged 79, who served his apprenticeship with the Carron Company, and subsequently became agent for the Skinningrove Iron Company. After the war he started business as an iron merchant on his own account, in which he continued until failing health necessitated his retirement.

MR. ALBERT ERNEST DOXFORD died on Tuesday, November 30, aged 69. Mr. Doxford was the only son of the late Sir Theodore Doxford. He became a director of William Doxford & Sons, Limited, Sunderland, shipbuilders and marine engineers, and was closely associated with the development of the Doxford Diesel engine. He retired from his directorate in 1920. He was a past president of the North-East Coast Institution of Engineers and Shipbuilders.

New Company

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Forster, Haworth & Company (Engineers), Limited, Gladstone Mills, Castle Northwich, Ches.—Capital £1,200. Mechanical engineers, ironfounders, etc. Directors: Sir Robert McDougall, W. Forster, E. Haworth and G. Haworth.

Contract Open

Filby, December 11.—Supplying and laying 2,800 yds. of 4-in. and 3-in. water mains of spun-iron unlined pipes or spun-iron concrete-lined pipes, for the Blofield and Flegg Rural District Council. Mr. L. McRoberts, clerk to the Rural District Council, Council Offices, Acle, Norwich.

Company Reports

Allied Ironfounders, Limited.—Interim dividend on the ordinary shares of 4 per cent.

John Brown & Company, Limited.—Interim dividend of 5 per cent., free of tax, on the ordinary shares.

Indian Iron & Steel Company, Limited.—Interim dividend on the ordinary shares of R.1 8a. a share (or 15 per cent.).

Aveling-Barford, Limited.—Dividend on the 5½ per cent. cumulative preference shares for the six months to December 27, 1937.

R. A. Lister & Company, Limited.—Final dividend of 5 per cent., plus a bonus of 6 per cent., making 16 per cent. for the year.

Revo Electric Company, Limited.—Interim dividend of 5 per cent. on the ordinary shares in respect of the financial year ending March 31, 1938.

Wellman Smith Owen Engineering Corporation, Limited.—Interim dividend of 5 per cent. for the year ending March 31, 1938, on the ordinary shares.

Henry Meadows, Limited.—Net profit for year ended August 31, after providing £9,427 for tax, £27,167; brought in, £8,029; dividend of 20 per cent.; carried forward, £6,564.

Dennis Bros., Limited.—Net profit for year ended September 30, £98,175; final dividend of 10d. a share, making 1s. 2d. on each 1s. share for the year; carried forward, £133,326.

Dunswart Iron & Steel Works, Limited.—Profit for year to June 30, £45,166; brought in, £15,027; depreciation, £5,000; taxation, £4,234; capital reconstruction expenses, Empire exhibition expenses, etc., £4,735; final dividend of 8 per cent. on the ordinary shares, making 14 per cent. for the year; carried forward, after preference dividend, £17,120.

Broom & Wade, Limited.—Net profit for year to September 30, including £14,826 in respect of profits of the subsidiary company, £51,982; brought in, £9,272; additional provision for taxation, £2,000; final dividend on the ordinary shares of 10 per cent., making 22½ per cent. for the year; carried forward, after preference dividend, £21,909.

David Brown & Sons (Huddersfield), Limited.—Profit for year ended September 30 (including income from investments, miscellaneous credits, &c.), after charging depreciation, £121,379; brought in, £114,612; tax and N.D.C., £43,265; dividends on preference shares for year, £14,975; dividend on the ordinary shares of 5 per cent., £10,550; carried forward, £167,201.

Forthcoming Events

DECEMBER 13.

Sheffield Society of Engineers and Metallurgists:—"Standardisation of Iron and Steel Products," Paper by A. F. Webber, at Mappin Hall, Department of Applied Science, St. George's Square, Sheffield, at 7.30 p.m.

DECEMBER 14.

Institute of Metals (Birmingham Section):—"Expert Use of the Microscope," Paper by Dr. H. Wrightson, at James Watt Memorial Institute, Birmingham, at 7 p.m.

Institute of Metals (Scottish Section):—"Modern Non-ferrous Castings and Their Engineering Interest," Paper by F. Hudson, at Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, at 7.30 p.m.

Institute of Metals (Swansea Section):—"Hot-Dipped and Electrodeposited Tin Coatings," Paper by D. J. Macnaughtan, at Y.M.C.A., Swansea, at 6.30 p.m.

DECEMBER 16.

Institute of Welding (Leeds Branch):—Smoking concert, at Griffin Hotel, at 7.30 p.m.

DECEMBER 17.

Institution of Mechanical Engineers:—"Steel Castings," Paper by F. Cousans, at Lincoln Technical College, Lincoln, at 7 p.m.

Institute of British Foundrymen

DECEMBER 16.

East Anglian Section:—"Factors in the Production of Aluminium Castings," Paper by H. W. Kechle, at Central Library, Ipswich, at 7.30 p.m.

DECEMBER 17.

Middlesbrough Branch:—"A Small Oil-fired Rotary Furnace and Its Products," Paper by E. W. Wynn, at Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough.

DECEMBER 18.

Newcastle Branch:—"Gating, Running and Pouring of Moulds for Grey-Iron Castings," Paper by T. Goodwin, at Neville Hall, Westgate Road, Newcastle-upon-Tyne, at 6.15 p.m.

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MANCHESTER OFFICE: 9, Albert Square. Telephone: Blackfriars 6130. Telegrams: "Genefax, Manchester." (Mr. S. G. Throssell).

MIDDLESBROUGH OFFICE: Halifax Bldgs, Exchange Place. Telephone: Middlesbrough 3313. Telegrams: "Genefax, Middlesbrough." (Mr. J. A. Williams).

CARDIFF OFFICE: 17, Windsor Place. Telephone: 3796. Telegrams: "Genefax, Cardiff." (Mr. F. E. Rutter).

Raw Material Markets

Although many producers of iron and steel still have considerable delivery arrears in respect of old contracts, a fair amount of new business has gone through following publication of the revised prices. Consumers generally are well employed, although there are exceptions, notably the light-castings makers and motor-car manufacturers. Owing to home commitments, export trade tends to be neglected, but there is definitely less business offering in this department.

Pig-Iron

MIDDLESBROUGH.—The present supply of foundry iron—derived from one blast furnace—is totally inadequate fully to meet consumers' demands and the transaction of new business is not an easy matter. It is believed that some expansion of output will shortly be made, but it will be a long time before the position becomes at all satisfactory and supplies will have still to be brought from other producing areas. For delivery up to the end of the year, No. 3 Cleveland G.M.B. is quoted at 106s. on the North-East Coast, with No. 1 foundry at 108s. 6d. and No. 4 foundry and No. 4 forge at 104s., less 5s. rebate. Inquiries for hematite have been profuse since the new quotations were made known and many contracts for deliveries over the first half of the year have been arranged. Makers have difficulty in sparing iron for the export trade.

LANCASHIRE.—The opportunity has been taken to purchase further supplies of forge and foundry pig-iron, but deliveries under old contracts still have to be made. Consumers are well employed, the machine-tool makers being especially so. For delivery in the Lancashire price zone, Derbyshire, Staffordshire and Lancashire brands of No. 3 foundry iron equal to Derbyshire, are quoted on the basis of 114s., with Northamptonshire at 112s. 6d., less 5s. rebate. There is very little Scottish foundry iron on the market; the price has been stabilised at around 141s. for delivery over the first half of next year in the Manchester district.

MIDLANDS.—Business in pig-iron is on a fair scale. Generally, consumers are able to obtain their full requirements, but some producers are behind with their commitments, and can only negotiate for comparatively small tonnages. Makers of light castings and motor manufacturers are not too active, and their needs do not amount to anything like the tonnage which they were taking a few months ago. For delivery to Birmingham and Black Country stations, the revised prices are 111s. for Derbyshire, Lincolnshire and North Staffordshire No. 3, and 108s. 6d. for Northamptonshire No. 3, less 5s. per ton rebate. Users of forge iron are heavy buyers. Low-phosphorus iron is quoted at from £6 7s. 6d. to £7 10s., according to phosphorus and silicon content. The demand aggregates to a substantial tonnage. Owing to the rather difficult price position, hematite producers are unwilling to sell ahead the full demands of the consumers, and orders for moderate-sized tonnages only are being accepted. For delivery to Birmingham and district, current prices are £6 13s. 6d. for East Coast No. 3 and £6 14s. 6d. for West Coast mixed numbers.

SCOTLAND.—Substantial tonnages of both foundry pig-iron and hematite have been sold during the past week for delivery in 1938. No. 3 Scottish foundry iron is quoted at 118s. f.o.t. furnaces, with No. 1 at 120s. 6d. Local steelworks continue to work to capacity, and they are hard pressed to maintain adequate deliveries. Current prices of steel-making irons are as follow:—Hematite mixed numbers, 123s.; Scottish basic, 107s. 6d.; English and Indian basic, 100s., all less 5s. per ton rebate, delivered steelworks. No. 3 Cleveland iron at 109s. f.o.t. Falkirk and 112s. f.o.t. Glasgow, less 5s. rebate, is only nominal, as no iron is available.

Coke

For delivery to Birmingham and district, the minimum price for best Durham coke is 55s. 9d., while Welsh coke is at between 55s. and 65s. per ton. Most consumers have covered their requirements up to the end of the winter, but they anticipate lower quotations in the summer and so are not disposed to book over the whole of 1938.

Steel

Steady conditions continue to rule in the steel market, and although there is a seasonal decline in the demand in some branches of the trade, it is less apparent than is usual at this time of the year. Consumers are eager to obtain deliveries against existing contracts and the steelmakers are hard pressed to keep pace with the specifications which are reaching them. It is certain that most of the works will enter the New Year with a large tonnage of unexecuted orders on their books, but their recent efforts to reduce arrears have been successful to some extent. There is still a certain stringency in the semi-finished steel department, but consumers are obtaining increased supplies of British and Continental material. The demand for finished steel is maintained, and although production continues at a record rate, it is passing immediately into consumption. Export trade remains quiet, but lately there have been signs of a revival in the demand.

Scrap

A revised schedule of scrap prices to become operative on January 1 was reached at a meeting between the British Iron and Steel Federation and the National Federation of Scrap Iron and Steel Merchants on December 1. There will be little change; some prices are slightly up; others slightly down. It is claimed that anomalies have been removed. New business is quiet. Deliveries under existing contracts are heavy and steelworks' scrap is particularly active.

Metals

Comment on the outlook for the non-ferrous metal markets is made in the weekly report issued by Brandeis, Goldschmidt & Company, Limited. Just as, after a decided boom, a severe depression follows, so it must follow that after a depression there will be a sharp recovery, states the report. In the United States these movements are usually exaggerated and much more pronounced than in Europe, and so it is this time. The firm believes that prices for most commodities will be higher next year, as trade is still good in Europe and will, no doubt, recover in the United States.

Copper.—Consumption of copper in Europe is maintained at a good rate. Buying on industrial account in this country is not heavy, but there are indications that consumers are taking more interest in the metal. Although most of the large primary producers in the United States continue to quote 11 cents, other concerns are selling at lower prices. Business remains quiet, but the market has shown some slight improvement.

Metal Exchange quotations were as follow:—

Cash.—Thursday, £39 17s. 6d. to £39 16s. 9d.; Friday, £40 10s. to £40 11s. 3d.; Monday, £41 8s. 9d. to £41 10s.; Tuesday, £40 8s. 9d. to £40 10s.; Wednesday, £40 5s. to £40 6s. 3d.

Three Months.—Thursday, £40 2s. 6d. to £40 5s.; Friday, £40 15s. to £40 16s. 3d.; Monday, £41 13s. 9d. to £41 15s.; Tuesday, £40 12s. 6d. to £40 13s. 9d.; Wednesday, £40 8s. 9d. to £40 10s.

Tin.—November tin statistics compiled by Mr. W. H. Gartsen (Henry Rogers, Sons & Company) indicate that the total visible supply of tin on November 30 was 18,067 tons, as compared with 18,421 tons on October 31. The carry-over in the Straits Settlements at the end of November was 3,676 tons, against 2,322 tons on October 31, while the carry-over at the Arnhem (Holland) smelter was 1,584, against 1,085 tons. It would appear that recent heavy buying in the United States has encouraged the market in this country and on Monday a much-improved tone was in evidence, the price rising above the £200 mark, but the quotation has since fallen below £195. Operations at the tinplate mills in the United States remain under 60 per cent. of normal capacity, but it is thought likely that better conditions will prevail now that tinplate prices for 1938 have been announced as unchanged. The International Tin Committee is to meet to-morrow (Friday) in order to fix the quota for the first quarter of the New Year. It is now thought that no reduction above 30 per cent. will be made—but the Committee may have other ideas.

Official quotations were as follow:—

Cash.—Thursday, £192 10s. to £193; Friday, £194 12s. 6d. to £194 15s.; Monday, £200 10s. to £200 15s.; Tuesday, £197 to £197 5s.; Wednesday £194 15s. to £195 5s.

Three Months.—Thursday, £191 10s. to £191 12s. 6d.; Friday, £193 12s. 6d. to £193 15s.; Monday, £199 15s. to £199 17s. 6d.; Tuesday, £195 15s. to £196; Wednesday, £193 15s. to £195.

Spelter.—The position of this market remains uncertain, but the tone has been stronger. Although reports have appeared stating that efforts are now being made to revive the International Zinc Cartel, no official news is forthcoming and it is the general opinion that the opposition to the Cartel would be too severe to facilitate a revival at the present time. The American price has declined to 5 cents per lb. East St. Louis. The American Bureau of Metal Statistics estimates the world output of spelter in October at 162,300 short tons, against 151,400 tons in the previous month.

Daily market prices:—

Ordinary.—Thursday, £15 15s.; Friday, £15 17s. 6d.; Monday, £16 5s.; Tuesday, £15 13s. 9d.; Wednesday, £15 10s.

Lead.—Consumers of lead in this country are well employed and demand is on a fair scale. The market is firmer and, given a reasonable chance, should gain some of the necessary confidence to permit a return to more stable conditions.

Day-to-day quotations:—

Soft Foreign (Prompt).—Thursday, £16 2s. 6d.; Friday, £16 7s. 6d.; Monday, £16 17s. 6d.; Tuesday, £16 3s. 9d.; Wednesday, £16 2s. 6d.

Scrap.—There is little change to report in the market for non-ferrous scrap metal and business remains quiet. Prices have shown small increases this week and thus sellers' expectations of higher quotations appear to be well founded. Orders are likely to be accepted on a freer scale as soon as prices move up to more normal levels.

Approximate selling prices for old metal:—New aluminium cuttings, £82; rolled, £67; cast, £40; foil, £94 to £98. Copper, £37 to £40; braziery, £35. Brass (clean), £23 to £25. Zinc, £9. Lead, £15 5s. Gunmetal, £38 to £39.

Company Meetings

Ley's Foundries & Engineering, Limited

The first ordinary general meeting of Ley's Foundries & Engineering, Limited, was held on December 1 at Vulcan Ironworks, Derby. MR. FRANCIS D. LEY, who presided, said the directors regarded the trading results as very satisfactory, although costs had increased under practically every heading, the main factor being the very large rise in the price of the exclusively English pig-irons used by Ley's Malleable Castings Company, Limited, in the manufacture of their "Black Heart" malleable-iron castings, including the chains and buckets for conveying plants marketed by the Ewart Chainbelt Company, Limited. Volume of output had increased by no less than 75 per cent. in the past four years. The increase in the demand for the products of both operating companies showed no signs of abating, and the directors would shortly take steps to enable them to cope with any increased volume of orders that could reasonably be anticipated. The exact form the expansion would take had not yet been definitely settled, but provisional plans for a new foundry had been prepared.

Irish Aluminium Company, Limited

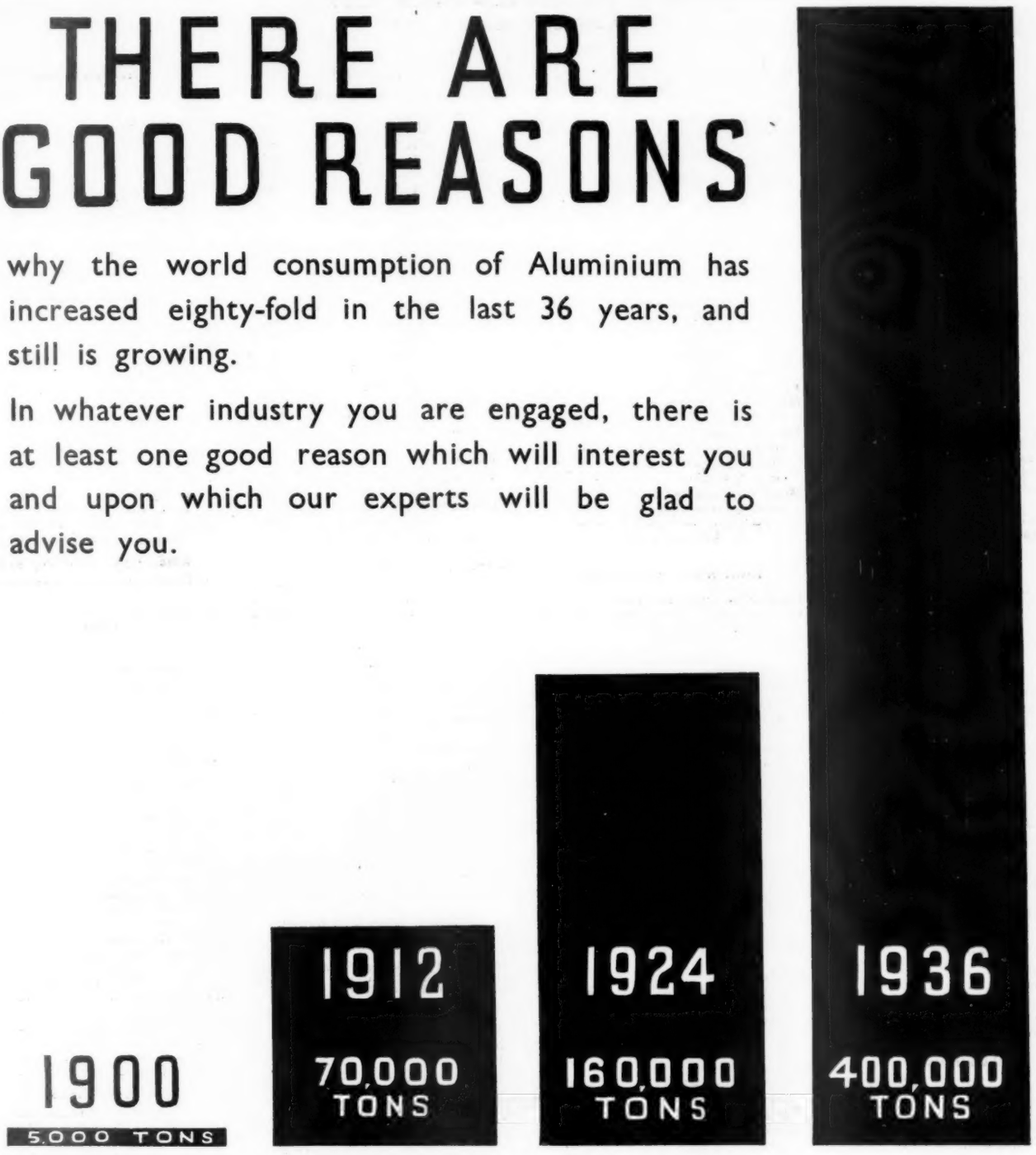
At the third annual meeting of the Irish Aluminium Company, Limited, the chairman, MR. S. B. MINCH, spoke of a change in the conditions under which the company operated. Up to last year, he said, the company had functioned under special licence from the Government, but since that time it had been brought under the Control of Industry Act, and Free State citizens held two-thirds of the capital. The company was one of the first industries to be set up within the new tariff system. The factory at Nenagh had been in full production for some time, and was represented in all the hardware stores of the Free State.

THE ATLAS STEEL FOUNDRY & ENGINEERING COMPANY, LIMITED, of Armadale, has increased its capital to £56,250 by the issue of 18,750 £1 bonus shares in the proportion of one bonus share for every two shares held.

THERE ARE GOOD REASONS

why the world consumption of Aluminium has increased eighty-fold in the last 36 years, and still is growing.

In whatever industry you are engaged, there is at least one good reason which will interest you and upon which our experts will be glad to advise you.



THE British Aluminium CO. LTD

HEAD OFFICE:
ADELAIDE HOUSE, LONDON, E.C.4. Telephone: Mansion House 5561 (6 lines). Telegrams: "Cryolite, London."

F.T.J. 12.37.

RAW MATERIALS—PRICE LIST

(Wednesday, December 8, 1937)

COPPER

	£ s. d.
Standard cash	40 5 0
Three months	40 8 9
Electrolytic	44 10 0
Tough	44 15 0
Best selected	45 5 0
Sheets	76 0 0
India	56 0 0
Wire bars	46 10 0
Ingot bars	46 10 0
H.C. Wire rods	50 0 0
Off. av. cash, Nov.	39 7 $4\frac{7}{11}$
Do., 3 mths., Nov.	39 13 $0\frac{21}{32}$
Do., Sttlmnt., Nov.	39 7 $7\frac{5}{11}$
Do., Electro, Nov.	44 18 $7\frac{7}{11}$
Do., B.S., Nov.	44 19 $8\frac{3}{11}$
Do., Wire bars, Nov.	45 16 $9\frac{9}{11}$
Solid drawn tubes	12½d.
Brazed tubes	12½d.
Wire	8¼d.

BRASS

Solid drawn tubes	11¼d.
Brazed tubes	13½d.
Rods, drawn	9½d.
Rods, extd. or rlld.	6½d.
Sheets to 10 w.g.	8½d.
Wire	8½d.
Rolled metal	8½d.
Yellow metal rods	6½d.

TIN

	£ s. d.
Standard cash	194 15 0
Three months	193 15 0
English	194 15 0
Bars	196 15 0
Straits	198 15 0
Eastern	196 0 0
Banca (nom.)	—
Off. av. cash, Nov.	190 13 $7\frac{7}{11}$
Do., 3 mths., Nov.	190 5 $1\frac{4}{11}$
Do., Sttlmt., Nov.	190 14 $3\frac{9}{11}$

SPELTER

	£ s. d.
Ordinary	15 10 0
Remelted	13 0 0
Hard	12 0 0
Electro, 99.9	19 6 3
English	17 0 0
India	15 0 0
Zinc dust	24 5 0
Zinc ashes	6 5 0
Off. aver., Nov.	15 17 $9\frac{9}{22}$
Aver., spot, Nov.	15 16 $1\frac{43}{44}$

LEAD

	£ s. d.
Soft foreign, ppt.	16 2 6
Empire (nom.)	17 0 0
English	18 5 0
Off. aver., Nov.	16 14 $2\frac{5}{11}$
Aver. spot, Nov.	16 14 $1\frac{19}{44}$

ALUMINIUM

Ingots	£100 to £105
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 to 1/4 lb.

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	29 0 0 to 29 10 0
Do., V.M. ex-whse.	29 0 0 to 29 10 0
Rods	23 10 0

ANTIMONY

	£ s. d.
English	81 0 0 to 82 0 0
Chinese, ex-whse. (nom.)	66 0 0
Crude, c.i.f.	38 0 0

QUICKSILVER

	£ s. d.
Quicksilver	13 0 3

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	14 10 0
45/50%	12 0 0
75%	17 0 0
Ferro-vanadium	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free	4/9 lb. Mo.
Ferro-titanium—	
20/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£21 to £22
Ferro-tungsten—	
80/85%	9/3 lb.
Tungsten metal powder—	
98/99%	9/6 lb.
Ferro-chrome—	
2/4% car.	34 15 0
4/6% car.	24 5 0
6/8% car.	24 0 0
8/10% car.	24 0 0
Ferro-chrome—	
Max. 2% car.	36 0 0
Max. 1% car.	38 5 0
Max. 0.5% car.	41 0 0
70% carbon-free	10d. lb.
Nickel—99.5/100%	£180 to £185
"F" nickel shot	£165 0 0
Ferro-cobalt, 98/99%	8/6 to 8/9 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese—	
76/80% loose	£18 15 0 to 19 5 0
76/80% packed	£19 15 0 to 20 5 0
76/80% export	£22 0 0
Metallic manganese—	
94/96% carbon-free	1/3 lb.

Per ton unless otherwise stated, basis 2-ton lots.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	3s. 10d.
Finished bars, 18% tungsten	5s. 0d.

Per lb. d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to $\frac{7}{16}$ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ¾ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£ s. d.	£ s. d.
South Wales (West)—		
Heavy steel, best	3 8 6	to 3 11 0
Mixed iron and steel	3 6 0	to 3 8 6
Heavy cast iron	3 8 6	to 3 11 0
Good machinery	3 17 6	
Cleveland—		
Heavy steel, best	3 7 0	to 3 9 6
Steel turnings	2 13 0	to 2 15 6
Heavy cast iron	4 5 0	
Heavy machinery	4 10 0	
Midlands—		
Short heavy steel	4 0 0	
Light cast-iron scrap	3 0 0	to 3 2 6
Heavy wrought iron	4 0 0	to 4 5 0
Steel turnings	2 5 6	to 2 8 0
Scotland—		
Heavy steel, best	3 5 0	to 3 7 6
Ordinary cast iron	4 7 6	to 4 10 0
Cast-iron borings	2 0 0	to 2 2 6
Wrot-iron piling	4 15 0	
Heavy machinery	4 15 0	to 4 17 6

London—Merchants' buying prices, delivered yard.

	£ s. d.
Copper (clean)	33 0 0
Brass	23 10 0
Lead (less usual draft)	13 10 0
Tea lead	11 0 0
Zinc	9 0 0
New aluminium cuttings	71 0 0
Braziery copper	30 0 0
Gunmetal	31 0 0
Hollow pewter	130 0 0
Shaped black pewter	92 0 0

PIG-IRON*

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	108/6
,, No. 3	106/-
,, No. 4	105/-
Forge No. 4	105/-
Hematite No. 1	123/-
Hematite M/Nos.	122/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	123/-
,, d/d Birm.	134/6
Malleable iron d/d Birm.	160/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	108/-
,, No. 3 fdry.	111/-
Northants forge	105/6
,, fdry. No. 3	108/6
,, fdry. No. 1	111/6
Derbyshire forge	108/-
,, fdry. No. 3	111/-
,, fdry. No. 1	114/-
Scotland—	
Foundry, No. 1, f.o.t.	120/6
,, No. 3, f.o.t.	118/-
Cleveland No. 3, Glasgow	112/-
,, ,, Falkirk	109/-
Scottish hem. M/Nos. d/d	123/-
Sheffield (d/d district)—	
Derby forge	105/6
,, fdry. No. 3	108/6
Lincs forge	105/6
,, fdry. No. 3	108/6
W.C. hematite	128/6
Lancashire (d/d eq. Man.)—	
Derby fdry, No. 3	114/-
Staffs fdry. No. 3	114/-
Northants fdry. No. 3	112/6
Cleveland fdry. No. 3	114/-
Glengarnock, No. 3	141/-
Clyde, No. 3	141/-
Monkland, No. 3	141/-
Summerlee, No. 3	141/-
Eglinton, No. 3	141/-
Gartsherrie, No. 3	141/-
Shotts, No. 3	141/-

(* Prices of hematite and basic pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton under certain conditions.)

FINISHED IRON AND STEEL

Usual district deliveries.

[A rebate of 15/- per ton for steel sections, plates and joists is obtainable in the home trade under certain conditions.]

Iron—	£ s. d.	£ s. d.
Bars (cr.)	13 5 0	to 13 15 0
Nut and bolt iron	11 12 6	to 12 2 6
Hoops	14 2 6	
Marked bars (Staffs) f.o.t.	15 15 0	
Gas strip	14 2 6	
Bolts and nuts, ¾ in. × 4 in.	17 10 0	and up
Steel—		
Plates, ship, etc.	11 8 0	to 11 10 6
Boiler plts.	11 18 0	to 12 0 6
Chequer plts.	13 0 6	
Angles	11 0 6	
Tees	12 0 6	
Joists	11 0 6	
Rounds and squares, 3 in. to 5½ in.	12 0 6	
Rounds under 3 in. to ¼ in. (Untested)	11 9 0	
Flats—8 in. wide and over	11 5 6	
,, under 8 in. and over 5 in.	11 10 6	
Rails, heavy	10 2 6	
Fishplates	14 2 6	
Hoops (Staffs)	12 4 0	
Black sheets, 24g. (4-t. lots)	15 15 0	
Galv. cor. shts. (,,)	19 10 0	
Galv. flat shts. (,,)	20 0 0	
Galv. fencing wire, 8g. plain	20 5 0	
Billets, soft, 100-ton lots	7 17 6	
Sheet bars	7 15 0	
Tin bars	7 15 0	

PHOSPHOR BRONZE

	Per lb. basis
Strip	11d.
Sheet to 10 w.g.	11½d.
Wire	12½d.
Rods	13½d.
Tubes	18½d.
Castings	15½d.

Delivery 3 cwt. free.
10% phos. cop. £33 above B.S.
15% phos. cop. £38 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	8d. to 1/2
Rolled—	
To 9 in. wide	1/2 to 1/8
To 12 in. wide	1/2½ to 1/8½
To 15 in. wide	1/2½ to 1/8½
To 18 in. wide	1/3 to 1/9
To 21 in. wide	1/3½ to 1/9½
To 25 in. wide	1/4 to 1/10
Ingots for spoons and forks	8d. to 1/4½
Ingots rolled to spoon size	11d. to 1/7½
Wire round—	
to 10g.	1/5½ to 2/0½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/4½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	25.76
No. 2 foundry, Valley	24.00
No. 2 foundry, Birm.	20.38
Basic, Valley	23.50
Malleable, Valley	24.00
Grey forge, Valley	23.50
Ferro-mang. 80%, seaboard	102.50
O.-h. rails, h'y, at mill	42.50
Billets	37.00
Sheet bars	37.00
Wire rods	47.00
	Cents.
Iron bars, Chicago	2.40
Steel bars	2.45
Tank plates	2.25
Beams, etc.	2.25
Skelp, grooved steel	2.10
Steel hoops	2.40
Sheets, black, No. 24	3.15
Sheets, galv., No. 24	3.80
Wire nails	2.75
Plain wire	2.90
Barbed wire, galv.	3.40
Tinplates, 100-lb. box	$5.35

COKE (at ovens)

Welsh foundry	42/6
,, furnace	37/6
Durham foundry	38/6
,, furnace	37/6
Scottish foundry	42/6
,, furnace	40/-

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes 20×14 per box	22/6 to 23/6
,, 28×20 ,,	45/- to 47/-
,, 20×10 ,,	35/- to 35/6
,, 18¾×14 ,,	25/- to 25/6
C.W. 20×14 ,,	19/6 to 20/-
,, 28×20 ,,	39/- to 40/-
,, 20×10 ,,	30/6 to 31/-
,, 18¾×14 ,,	21/6 to 22/-

SWEDISH CHARCOAL IRON & STEEL

	£ s. d.	£ s. d.
Pig-iron	£12 0 0	to £13 0 0
Bars-hammered, basis	£20 0 0	to £22 0 0
Bars and nail-rods, rolled, basis	£19 0 0	to £20 0 0
Blooms	£18 0 0	to £19 0 0
Keg steel	£30 0 0	to £35 0 0
Faggot steel	£20 0 0	to £25 0 0
Bars and rods dead soft st'l	£19 0 0	to £20 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

			£	s.	d.	
Dec.	2	..	39	17	6	dec. 5/-
,,	3	..	40	10	0	inc. 12/6
,,	6	..	41	8	9	,, 18/9
,,	7	..	40	8	9	dec. 20/-
,,	8	..	40	5	0	,, 3/9

Electrolytic Copper

			£	s.	d.	
Dec.	2	..	44	0	0	No change
,,	3	..	45	0	0	inc. 20/-
,,	6	..	46	0	0	,, 20/-
,,	7	..	44	10	0	dec. 30/-
,,	8	..	44	10	0	No change

Standard Tin (cash)

			£	s.	d.		
Dec.	2	..	192	10	0	inc.	15/-
,,	3	..	194	12	6	,,	42/6
,,	6	..	200	10	0	,,	117/6
,,	7	..	197	0	0	dec.	70/-
,,	8	..	194	15	0	,,	45/-

Tin (English ingots)

			£	s.	d.		
Dec.	2	..	192	10	0	inc.	15/-
,,	3	..	194	12	6	,,	42/6
,,	6	..	200	10	0	,,	117/6
,,	7	..	197	0	0	dec.	70/-
,,	8	..	194	15	0	,,	45/-

Spelter (ordinary)

			£	s.	d.		
Dec.	2	..	15	15	0	dec.	3/9
,,	3	..	15	17	6	inc.	2/6
,,	6	..	16	5	0	,,	7/6
,,	7	..	15	13	9	dec.	11/3
,,	8	..	15	10	0	,,	3/9

Spelter (Electro, 99.9 per cent.)

			£	s.	d.		
Dec.	2	..	19	10	0	dec.	1/3
,,	3	..	19	13	9	inc.	3/9
,,	6	..	20	1	3	,,	7/6
,,	7	..	19	10	0	dec.	11/3
,,	8	..	19	6	3	,,	3/9

Lead (soft foreign, prompt)

			£	s.	d.		
Dec.	2	..	16	2	6	dec.	2/6
,,	3	..	16	7	6	inc.	5/-
,,	6	..	16	17	6	,,	10/-
,,	7	..	16	3	9	dec.	13/9
,,	8	..	16	2	6	,,	1/3

Lead (English)

			£	s.	d.		
Dec.	2	..	18	5	0	No	change
,,	3	..	18	10	0	inc.	5/-
,,	6	..	19	0	0	,,	10/-
,,	7	..	18	5	0	dec.	15/-
,,	8	..	18	5	0	No	change

AVERAGE MONTHLY PRICES OF FURNACE COKE D/D MIDDLESBROUGH

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1905	0 14 9	0 15 3	0 15 3	0 15 3	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 9	0 17 0	0 15 5½
1906	0 17 6	0 17 6	0 17 0	0 17 0	0 17 0	0 16 6	0 17 0	0 17 0	0 18 3	0 18 6	0 19 0	1 0 0	0 17 8½
1907	1 4 6	1 5 0	1 5 0	1 0 6	1 2 0	1 1 0	1 1 0	1 1 0	1 2 0	1 1 6	1 0 0	0 17 0	1 1 8½
1908	0 16 0	0 16 0	0 15 6	0 16 0	0 16 3	0 16 0	0 15 6	0 15 6	0 15 6	0 15 3	0 16 0	0 16 0	0 15 9½
1909	0 16 0	0 15 3	0 15 0	0 14 9	0 15 6	0 15 9	0 15 6	0 15 6	0 16 6	0 17 0	0 17 6	0 17 0	0 16 11½
1910	0 8 4½	0 18 6½	0 18 0	0 18 0	0 17 10½	0 17 0	0 16 1½	0 15 9½	0 15 11	0 16 0	0 15 9½	0 15 8	0 16 11
1911	0 16 0	0 15 10½	0 15 6	0 15 3	0 14 9	0 14 6	0 14 6	0 14 6	0 14 6	0 14 11½	0 15 0½	0 16 3½	0 15 1½
1912	0 17 3	0 17 3	0 18 6	0 18 10	0 19 0	0 19 4½	0 19 10½	1 0 9½	1 2 9	1 4 1½	1 5 8½	1 8 6	1 1 0
1913	1 5 9	1 4 11	1 5 0	1 5 0	1 4 9½	1 0 4½	0 19 5½	0 18 3	0 18 0	0 18 2½	0 18 6	0 18 6	1 1 4½
1914	0 18 2	0 17 1	0 17 0	0 17 0	0 17 4	0 17 6	0 17 6	0 18 5	0 18 4	0 17 9	0 17 6	0 18 5	0 17 8
1915	0 17 10½	0 17 9	1 0 4½	1 7 7½	1 9 4½	1 10 7½	1 9 7	1 7 3	1 5 4	1 4 9	1 9 6	1 13 0	1 6 1
1916	1 10 9	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6½
1917	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 14 3	1 15 6	1 11 2½
1918	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6
1919	1 15 6	1 15 6	1 15 6	1 15 6	2 1 6	2 1 6	2 3 9	2 10 6	2 10 6	2 10 6	2 10 6	2 10 6	2 3 8
1920	2 12 3	2 14 0	2 19 0	2 19 0	3 3 8	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 2 6
1921	3 1 0½	2 19 0	2 16 0	2 7 0	2 6 6	2 6 6	2 0 6	2 0 0	1 12 11	1 12 9	1 10 4½	1 8 3	2 3 6½
1922	1 7 0½	1 8 1½	1 9 7½	1 8 4½	1 7 11½	1 7 3	1 6 9½	1 6 10½	1 7 0½	1 10 2½	1 10 0	1 9 11½	1 8 2½
1923	1 11 3	1 14 6	2 0 1½	2 2 8½	2 4 4½	2 2 10½	2 1 0½	2 1 6	2 0 9½	1 18 9	1 18 8½	1 18 3	1 19 7½
1924	1 16 6½	1 14 9	1 11 11½	1 10 0½	1 8 1½	1 7 8½	1 7 3	1 6 3	1 6 0	1 5 0	1 5 0	1 5 0	1 9 6½
1925	1 4 10½	1 4 1½	1 13 3	1 2 4½	1 2 2½	1 1 5½	1 1 3½	1 4 9	0 18 10½	0 18 4½	0 19 6½	1 1 4½	1 2 8½
1926	1 2 1½	1 0 9	0 19 2½	0 18 6½	*	*	*	*	*	*	*	1 5 0	1 1 7½
1927	1 5 6	1 4 9½	1 6 1½	1 3 9	1 2 6	1 0 8½	0 19 4½	0 19 0	0 18 7½	0 18 0	0 17 10½	0 17 6	1 1 1½
1928	0 17 6	0 17 10½	0 18 0½	0 17 11½	0 17 8½	0 17 6½	0 17 7½	0 17 6½	0 17 6	0 17 7½	0 17 7½	0 17 6	0 17 8
1929	0 17 7½	0 18 0	0 19 0	0 19 6½	0 18 10½	0 19 10½	1 1 3½	1 1 8½	1 3 0	1 3 6	1 3 8	1 3 1½	1 0 9½
1930	1 2 6½	1 1 3	1 0 3	0 19 1½	0 17 7	0 16 10½	0 16 6	0 16 6	0 16 9	0 17 0	0 17 0	0 17 0	0 18 2½
1931	0 17 0	0 16 7½	0 16 0	0 16 0	0 15 11	0 15 5	0 15 1	0 15 0	0 15 0	0 16 9	0 17 0	0 16 6	0 16 0½
1932	0 17 0	0 16 11½	0 16 5½	0 15 9	0 15 7½	0 15 6	0 15 6	0 14 9½	0 14 6½	0 14 6	0 14 6	0 15 4	0 15 6½
1933	0 16 0½	0 15 11½	0 15 6½	0 15 6	0 15 6	0 15 6	0 15 6	0 15 8½	0 16 1½	0 17 0	0 17 6	0 18 0	0 16 1½
1934	0 19 1½	1 0 6	1 0 2	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	0 19 11½
1935	1 0 0	0 19 6½	0 19 0½	0 19 0	0 19 0	0 19 0	0 19 0	0 19 0	0 18 9½	0 19 3½	1 1 2½	1 1 2½	0 19 2½
1936	1 2 0	1 2 11½	1 3 2½	1 4 0	1 4 11½	1 4 3½	1 5 1	1 4 7½	1 4 6	1 4 6	1 4 6	1 4 6	1 4 1
1937	1 5 3½	1 5 10½	1 7 7½	1 13 5	1 15 0	1 19 3½	1 18 6½	2 0 0	2 0 0	2 1 10	2 2 0	—	—

* Strike period. ‖ Five months.

WILLIAM JACKS & COMPANY,
WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.
13, RUMFORD STREET, LIVERPOOL.

PIG

IRON

FOR EVERY TYPE OF CASTING

NON-FERROUS METALS

REFRACTORIES — COKE — SAND
FERRO-SILICON—FERRO-CHROME

WILLIAM JACKS & COMPANY,
CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.
ZETLAND ROAD, MIDDLESBROUGH.

Notice

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

FIRST-CLASS Moulder, green, dry sand, seeks situation. Three years' experience assistant foreman, jobbing, repetition, ordinary, high-duty cast irons. Young, keen, energetic. Guaranteed to get results.—Box 688, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WORKS Manager required to take entire charge of foundry, and complementary pattern and machine shops. Must be experienced in the production of light soft grey-iron castings, mainly machine moulded; laboratory assistance for metal control. Good organiser, able to fix piece prices and obtain high production. About 300 hands are employed and the position is progressive. Payment by salary and bonus. Applicants are requested to give all relevant information, copies of references, testimonials, etc., which will be treated in strict confidence.—Box 700, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOUNDRY Foreman with thoroughly practical training and experience requires re-engagement. Experience includes general engineering castings up to 20 tons, also repetition work, machine and plate (315)

FOUNDRY or Works Manager. Position required by young man with considerable experience as Manager and Superintendent, including non-ferrous work. Modern production and costing methods. (316)

FINANCIAL

AN established Scottish Steel Foundry wishing to develop would consider introduction of further Capital, with or without active part in management.—Box 692, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY

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